

<p>1 Friday, 17 June 2016 2 (09.45 am) 3 PROFESSOR GERALDINE THOMAS (continued) 4 MR HEPPINSTALL: My Lord, just before Dr Busby resumes, I 5 hope that SB22 has reached your table. I sent three up 6 this morning. Ah, they are in the racks. 7 MR JUSTICE BLAKE: Oh, right, I see. Yes, very good. 8 MR HEPPINSTALL: I am very grateful to Hogan Lovells for 9 providing the index. We've put some material in there 10 and then it occurred to us that you may have marked your 11 own copies. 12 MR JUSTICE BLAKE: Well, I might have done but I can 13 substitute. 14 MR HEPPINSTALL: If you are missing anything, then please 15 let us know. 16 MR JUSTICE BLAKE: I will try and do that in the course of 17 this morning. (Pause) 18 Where are we going to put the materials which we've 19 been provided by Dr Busby overnight? 20 MR HEPPINSTALL: I going to put them behind the relevant 21 abstracts. 22 MR JUSTICE BLAKE: Abstracts. Righty ho. 23 MR HEPPINSTALL: I think their location is noted upon them, 24 as I understand it. (Pause) 25 MR JUSTICE BLAKE: We'll do that. We won't put them into</p> <p style="text-align: center;">Page 1</p>	<p>1 Q. For evacuees. But presumably for people who were 2 outside the exclusion zone, that dose would have been 3 less? 4 A. Yes, considerably less. 5 Q. Well, would it have been -- I mean, can you give some 6 sort of idea of how much less? 7 A. If you look in the UNSCEAR report of 2008 I'm sure 8 you'll find in the tables there a full table of various 9 doses, various ages, because it varies on the ages of 10 the children and the various areas and that will give 11 you all the information that you want. 12 Q. Can you tell us approximately what the increase was 13 numerically? 14 A. To date, it's around about 6,000 thyroid cancers that 15 are in excess of what we would expect in that 16 population. 17 Q. So what would that be as an excess fraction? For 18 instance, was it twice or five times? 19 A. No, it's considerably higher than that and it varies 20 depending on the area. It's impossible to give you 21 precise details unless the question is precise enough 22 I'm afraid. 23 Q. You could say it's not more than 20 times? 24 A. In some areas it's not. In some areas it's barely 25 raised, in other areas where the dose was higher -- it</p> <p style="text-align: center;">Page 3</p>
<p>1 the generic 22. 2 Good, thank you very much. Yes. 3 Cross-examination by DR BUSBY (continued) 4 DR BUSBY: Good morning, Professor Thomas. 5 A. Good morning. 6 Q. It might help if I just outline where I think we've got 7 to and then we can continue from there. 8 Because of the problem that you had with the 9 abstract of the paper on uranium we had to break off 10 from the uranium issue and so then we moved to the issue 11 of thyroid cancer -- 12 MR JUSTICE BLAKE: Your voice is a bit low. Can you pick it 13 up a little bit? 14 DR BUSBY: I'm sorry. So we then turned to the question of 15 thyroid cancer in Chernobyl, in the Chernobyl affected 16 areas. 17 A. Yes. 18 Q. Now, you agreed with me that there was a significant 19 rise in the incidence of thyroid cancer in the areas 20 affected by Chernobyl? 21 A. In those who were children at the time of the accident, 22 yes. 23 Q. And we agreed, I thought you said, that the accepted 24 mean dose was 500 millisieverts? 25 A. For evacuees.</p> <p style="text-align: center;">Page 2</p>	<p>1 is related to dose. In those areas where the dose was 2 highest, which is basically the Gomel area of Belarus, 3 it's about 100 fold in some age groups. But again, it's 4 not a simple equation. You have to bear in mind that 5 the susceptibility is different at different ages of 6 exposure, different lengths of time studying afterwards, 7 and we're not through the end of it yet. So it's 8 important to bear those caveats in mind. 9 Q. What I am sort of trying to get to is what would have 10 been predicted in that population on the basis of the 11 ICRP risk model? 12 A. Sorry, I can't comment on that because it's such 13 a variation. It depends on what dose people had. 14 Q. Well, I think what I am trying to -- 15 A. I can tell you what is predicted overall, based on 16 Elisabeth Cardis' predictions, which is up to 2050 about 17 16,000 excess thyroid cancers in those areas. Now she 18 will have used the ICRP risk model. 19 Q. So what would have been the background rate over that 20 period of time? This a very rare cancer. 21 A. The background rate in children aged under 14 varies 22 between 0.5 per million per year to 1.5 per million per 23 year across the globe. It's probably in that area, 24 around about 1, because it is moderately iodine 25 deficient.</p> <p style="text-align: center;">Page 4</p>

<p>1 Q. Do you know what the population of Belarus is?</p> <p>2 A. Not offhand, no.</p> <p>3 Q. Would you disagree if I said it was 3 million?</p> <p>4 A. Probably. That's probably about right. I would think</p> <p>5 it was nearer 6, actually, but I could be wrong, and of</p> <p>6 course there's been considerable migration from Belarus</p> <p>7 since the accident so it depends on when you are asking</p> <p>8 when that population was there.</p> <p>9 Q. As one might expect, I guess, but you just said that the</p> <p>10 risk -- that the background rate was less than 1</p> <p>11 per million.</p> <p>12 A. No, I said it varies. It was probably about 1</p> <p>13 per million per year.</p> <p>14 Q. So in a population of 3 million you would expect 3</p> <p>15 cancers per year?</p> <p>16 A. Yes, but that's not children. The population is not</p> <p>17 3 million children.</p> <p>18 Q. No, of course not, but it includes children?</p> <p>19 A. Yes.</p> <p>20 Q. If we take the number of children -- and I think you</p> <p>21 called children 0 to 18?</p> <p>22 A. 0 to under 14 is the accepted conventional age at which</p> <p>23 you cease to be a child internationally.</p> <p>24 Q. Okay, so --</p> <p>25 MR JUSTICE BLAKE: For scientific purposes. Not for the</p> <p style="text-align: center;">Page 5</p>	<p>1 are not talking about thyroid cancer in the appellants.</p> <p>2 MR JUSTICE BLAKE: I can see you are laying foundations for</p> <p>3 a question but I think you might want to get on to the</p> <p>4 actual question and put the proposition you are doing</p> <p>5 because otherwise it is always a risk we are going to be</p> <p>6 distracted into an analysis of the Chernobyl children.</p> <p>7 I can see why it might have relevance to some of these</p> <p>8 questions but if you would like to get to the point.</p> <p>9 DR BUSBY: My Lord, the point is -- I am not -- the problem</p> <p>10 is I have to rely upon the expertise of</p> <p>11 Professor Thomas, which is considerable -- it is her</p> <p>12 area of research --</p> <p>13 MR JUSTICE BLAKE: But it's --</p> <p>14 DR BUSBY: -- to tell us whether the ICRP risk model --</p> <p>15 MR JUSTICE BLAKE: If you want to find out from -- if you</p> <p>16 want to put the question that you are leading up to,</p> <p>17 it's probably a good time to do so.</p> <p>18 DR BUSBY: Does the ICRP risk model predict the enormous</p> <p>19 increase in childhood thyroid cancer that was found</p> <p>20 after the Chernobyl accident on the basis of the dose of</p> <p>21 500 millisieverts --</p> <p>22 A. No, because --</p> <p>23 Q. No?</p> <p>24 A. I'm sorry, you are using the wrong context for this.</p> <p>25 You can't base it on one single dose which is a mean</p> <p style="text-align: center;">Page 7</p>
<p>1 conventional --</p> <p>2 A. Not for law purposes, but for scientific purposes. Most</p> <p>3 of the childhood cancer registers stop at 14, my Lord.</p> <p>4 DR BUSBY: So in a population of 3 million, assuming the</p> <p>5 population is even square, that is to say that every age</p> <p>6 group is equally represented, and we know that isn't</p> <p>7 true but just for the purposes of argument, let's assume</p> <p>8 that there are 10 age groups up to age 70, and the first</p> <p>9 age group is the 0 to 14-year-olds, would that be</p> <p>10 roughly reasonable?</p> <p>11 A. Again I would refer you to the UNSCEAR report. I don't</p> <p>12 carry those sort of figures around in my head I'm</p> <p>13 afraid.</p> <p>14 Q. No, you don't need to. I'm just saying that we can get</p> <p>15 some idea -- I mean not as experts but just as ordinary</p> <p>16 people -- of the approximate population of 0 to</p> <p>17 14-year-olds in a population of 3 million. I mean, for</p> <p>18 example --</p> <p>19 A. If you look at the report, I think you'll find the</p> <p>20 accurate figures are there and that would be far better</p> <p>21 than me speculating.</p> <p>22 Q. It wouldn't be a speculation because we need to show</p> <p>23 whether the ICRP risk model -- or this is sort of where</p> <p>24 I am going here --</p> <p>25 A. I can't see why this is particularly relevant when we</p> <p style="text-align: center;">Page 6</p>	<p>1 dose which only a certain number of people were exposed</p> <p>2 to. The risk model is much more complicated than that</p> <p>3 and I think you are better directing your questions to</p> <p>4 somebody who is a trained epidemiologist.</p> <p>5 Q. I will do that.</p> <p>6 A. My interest is in the molecular pathology of thyroid</p> <p>7 cancer and I'm not a trained epidemiologist.</p> <p>8 Q. So --</p> <p>9 A. I think the context of your question is wrong, I'm</p> <p>10 afraid.</p> <p>11 Q. So I think what your answer, is yes, or you don't know?</p> <p>12 A. I'm not answering the question because I don't think I'm</p> <p>13 equipped to answer that. Based on your question -- does</p> <p>14 500 millisieverts predict the increase? -- I would have</p> <p>15 to know exactly how many children were exposed to</p> <p>16 500 millisieverts to answer your question and I don't</p> <p>17 have that information I'm afraid.</p> <p>18 Q. We can work that out, can't we?</p> <p>19 A. No, we can't work that out. The dosimetry needs to be</p> <p>20 worked out. I'm sorry, all the information you need is</p> <p>21 in that UNSCEAR annex and you should be able to tell</p> <p>22 from that.</p> <p>23 Q. I'm sorry, I'm just checking my phone is off in case it</p> <p>24 starts bleeping at me.</p> <p>25 All right, I don't think I can go any further with</p> <p style="text-align: center;">Page 8</p>

<p>1 that line of argumentation. I just now want to go to 2 Fukushima, where we have -- so my question here is: was 3 there an increase in thyroid cancer after the Fukushima 4 Daiichi accident.</p> <p>5 A. No.</p> <p>6 Q. There was not?</p> <p>7 A. There was not. There was a screening programme put in 8 place which detects thyroid cancers that occur in that 9 population earlier.</p> <p>10 Q. Right.</p> <p>11 A. But that does not constitute an increase due to the 12 radiation.</p> <p>13 Q. No. Well, can we now go to SB6/75. Do you have it?</p> <p>14 A. Yes.</p> <p>15 Q. Do you agree that this paper by Tsuda and co-workers 16 found a significant increase in thyroid cancer as 17 a result of ultrasound examination of a population of 18 380,000 people aged 0 to 18 in the Fukushima Daiichi 19 constituency or whatever?</p> <p>20 A. Whether it is an increase, you need to have a control 21 population to determine whether what you are seeing is 22 a screening effect, therefore it would have been there 23 anyway, you just didn't know it was there, or whether 24 it's a genuine increase. If you compare this with other 25 papers that have been written looking at control</p> <p style="text-align: center;">Page 9</p>	<p>1 The second is you say this paper has been subject to 2 some criticisms as to methodology.</p> <p>3 A. Huge criticism.</p> <p>4 MR JUSTICE BLAKE: Right.</p> <p>5 A. By people who are far better qualified to look at the 6 methodology in this paper than I am.</p> <p>7 MR JUSTICE BLAKE: You think we have the benefits of those 8 papers somewhere?</p> <p>9 A. You have. I certainly made sure they were in your 10 bundle, my Lord.</p> <p>11 MR JUSTICE BLAKE: Okay. One second.</p> <p>12 The third part was you say that you would need, in 13 order to answer the question that Dr Busby has posed to 14 you, i.e. whether it's an increase as opposed to 15 a detection of greater numbers --</p> <p>16 A. Exactly.</p> <p>17 MR JUSTICE BLAKE: -- you also have to look at other 18 material --</p> <p>19 A. You would have to compare it with a control population. 20 We do not routinely use this sort of sensitive 21 ultrasound to screen populations of this age. So you 22 have to have some form of control to compare this with 23 to know whether it is a genuine increase --</p> <p>24 MR JUSTICE BLAKE: Yes.</p> <p>25 A. -- or whether it's actually due to the method you are</p> <p style="text-align: center;">Page 11</p>
<p>1 populations at lamori and three other prefectures using 2 exactly the same technology, the frequency is exactly 3 the same. And in fact this paper caused an awful lot of 4 controversy because it's so poorly written and I think 5 my Lord in the bundles there are several angry papers 6 saying how bad this paper actually is.</p> <p>7 MR JUSTICE BLAKE: Well, I just want to get a gist of the 8 answer. So you don't agree with the proposition --</p> <p>9 A. I don't agree -- they chose -- they have detected more 10 thyroid cancers. Whether that is an increase is 11 a different matter.</p> <p>12 MR JUSTICE BLAKE: You make a distinction between the 13 detection of more thyroid cancers --</p> <p>14 A. And a genuine increase.</p> <p>15 MR JUSTICE BLAKE: -- and an increase in the rate of 16 detection?</p> <p>17 A. Absolutely.</p> <p>18 MR JUSTICE BLAKE: I'll just get that down first, if I may.</p> <p>19 (Pause)</p> <p>20 DR BUSBY: So --</p> <p>21 MR JUSTICE BLAKE: Hang on just a second.</p> <p>22 DR BUSBY: All right.</p> <p>23 MR JUSTICE BLAKE: That's your first part --</p> <p>24 A. That's a very important distinction, my Lord.</p> <p>25 MR JUSTICE BLAKE: I've got that down. Thank you very much.</p> <p style="text-align: center;">Page 10</p>	<p>1 using to detect.</p> <p>2 MR JUSTICE BLAKE: The question I am now going to ask is 3 whether to your knowledge that exercise has been 4 conducted.</p> <p>5 A. Yes.</p> <p>6 MR JUSTICE BLAKE: It has been?</p> <p>7 A. It has. Not on the same size population, and in fact 8 the Japanese were advised because they took expert 9 advice before they set up these surveys, to do a control 10 population of a similar size. But as I'm sure you can 11 imagine it's an extremely expensive and time-consuming 12 thing to be doing and you worry more people by screening 13 a population. So on balance they decided they would 14 conduct a smaller study in prefectures that were not 15 affected because obviously there is a difference as well 16 with the number of thyroid abnormalities you find in 17 different populations. So they chose other prefectures 18 that were not exposed.</p> <p>19 MR JUSTICE BLAKE: So they studied other prefectures on a 20 smaller scale, then they have the control at, what, 21 screening at the same age?</p> <p>22 A. Screening at the same age and exactly the same 23 technology, which is important because I'm sure you're 24 aware ultrasound varies.</p> <p>25 MR JUSTICE BLAKE: Well, yes. I could be.</p> <p style="text-align: center;">Page 12</p>

1 **A. Your medical colleague I'm sure will be aware.**
 2 MR JUSTICE BLAKE: So that's the point.
 3 **A. Mm.**
 4 MR JUSTICE BLAKE: Right. Okay. Thank you.
 5 DR BUSBY: So let's just get this absolutely straight.
 6 Professor Tsuda here, who wrote this paper into a very
 7 estimable journal that was a journal of the -- I read it
 8 here for you. It's the International Society for
 9 Environmental Epidemiology.
 10 **A. Yes.**
 11 **DR BUSBY: Which is a well respected organisation that was**
 12 **founded --**
 13 **A. I think it has less respect after publishing this from**
 14 **an awful lot of very good epidemiologists, I'm afraid.**
 15 Q. It would therefore have been through quite stringent
 16 peer review?
 17 **A. Peer review is a mixed bag. Sometimes the peer review**
 18 **is good, sometimes the peer review is not so well**
 19 **conducted. So I wouldn't necessarily say that peer**
 20 **review per se guarantees good papers.**
 21 Q. But this Tribunal, the level of proof in this Tribunal
 22 is much less stringent so could I ask you if you would
 23 consider that there might possibly be an increase,
 24 a significant increase in thyroid cancer after an
 25 exposure from Fukushima?

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1 **A. No, the doses were 100 fold lower -- yes, 100 fold**
 2 **lower. They were 4.2 millisieverts was the average**
 3 **thyroid dose in children from that area. 360,000**
 4 **children were exposed to varying doses --**
 5 MR JUSTICE BLAKE: Keep it slow. I know you are very
 6 enthusiastic to inform us but absorbing the information,
 7 let alone writing it down, is quite a challenging task.
 8 **A. Sorry. The dose was much, much lower than from**
 9 **Chernobyl, so instead of 500 millisieverts from the**
 10 **evacuated population mean dose, it was 4.2 millisieverts**
 11 **mean dose. So the exposure was lower, the dose was**
 12 **lower, therefore the effect would be predicted to be**
 13 **lower than was seen at Chernobyl.**
 14 **It was a much smaller population, 360,000 children,**
 15 **of the age that we know is more susceptible to iodine --**
 16 MR JUSTICE BLAKE: In Japan or in Chernobyl?
 17 **A. 360,000 children in the Fukushima prefecture and in fact**
 18 **very small -- the Fukushima prefecture is huge, so it's**
 19 **a very small part of the prefecture that is affected by**
 20 **this, whereas for a comparison in the areas around**
 21 **Chernobyl, 10 million children were exposed to varying**
 22 **doses but the average in the most contaminated area was**
 23 **500 millisieverts.**
 24 MR JUSTICE BLAKE: Thank you.
 25 **A. So --**

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1 MR JUSTICE BLAKE: Yes?
 2 **A. -- if you just simply do the maths and you use the**
 3 **frequency that we would expect from the data we have**
 4 **from Chernobyl, you would see less than one cancer if**
 5 **the dose had been the same as at Chernobyl, and because**
 6 **the dose is so much lower you are just not going to see**
 7 **any thyroid cancers. So the thyroid cancer incidence**
 8 **rate will not be raised statistically significantly in**
 9 **such a way that we could see it.**
 10 MR JUSTICE BLAKE: Yes.
 11 DR BUSBY: Well, just parenthetically here, you just
 12 mentioned to the Tribunal, and correct me if I'm wrong,
 13 that 10 million children in Chernobyl were exposed to --
 14 **A. In the areas that were bordering Chernobyl, so that**
 15 **includes northern Ukraine, southern Belarus and in**
 16 **particular the Bryansk area of Russia as it now is**
 17 Q. We just agreed that the whole population of Belarus is
 18 3 million.
 19 **A. I'm not talking about Belarus. I said northern Ukraine**
 20 **--**
 21 MR JUSTICE BLAKE: Other countries outside Belarus were
 22 affected by Chernobyl?
 23 **A. Yes, it wasn't just Belarus.**
 24 **DR BUSBY: Do you know what the population of the Ukraine**
 25 **is?**

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1 **A. Huge, but in that area it was only a certain part of the**
 2 **area of Ukraine that was -- again, if you look in**
 3 **UNSCEAR you will find all of these details.**
 4 **DR BUSBY: I think we need to go to these details now.**
 5 MR JUSTICE BLAKE: Right.
 6 DR BUSBY: Because if the population of the whole of the
 7 Ukraine is 8 million and the population of the whole of
 8 Belarus is 3 million, that means we have, if I've done
 9 my sums right, 11 million people adults in --
 10 MR JUSTICE BLAKE: I think you had better look at the
 11 UNSCEAR documentation.
 12 **A. My Lord, not everywhere in Belarus was exposed. Teppus**
 13 **was not exposed, which is the Northern Oblast, and it's**
 14 **only the Northern Oblasts of Ukraine, and there were**
 15 **about five or six of them, that were actually exposed to**
 16 **the iodine. Because it has such a short half life, it**
 17 **does not go very far.**
 18 MR JUSTICE BLAKE: I think at the moment there's simply
 19 a debate about how large a population is affected.
 20 DR BUSBY: I think that is rather the point, my Lord.
 21 MR JUSTICE BLAKE: I have that bit, but the point is we are
 22 not going to be making good use of the time by having an
 23 exchange as to how many people live in different parts.
 24 So if you have the hard data, let's go to it and then
 25 the witness can comment upon it, but rather than

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<p>1 debating between the two of you how many people live in 2 the northern part of Ukraine, Russia, et cetera, 3 et cetera, et cetera, either if you have the goods let's 4 go there, and if not we'd better move on. 5 DR BUSBY: My Lord, the witness is giving evidence about the 6 increase in thyroid cancer in Fukushima. She is 7 depending upon an argument relating to the population 8 exposed after Chernobyl. She has told us that there are 9 10 million children exposed after Chernobyl. This is 10 frankly absurd -- 11 MR JUSTICE BLAKE: Dr Busby, are you going to go to the 12 documentation about these matters or not? 13 DR BUSBY: I'll leave it at that, my Lord. I think we've 14 made the point here. 15 MR JUSTICE BLAKE: I'm not sure you have made any point, but 16 if you want to, please do. So put your questions. 17 DR BUSBY: Yes. Do you agree that the population of 18 children exposed to radio-iodine following the Chernobyl 19 accident cannot possibly be anywhere near the 10 million 20 that you have just told us? 21 A. No, I absolutely do not and I think you should read that 22 document. I'm sorry, that is common knowledge. 23 MR JUSTICE BLAKE: I think we have that point. Thank you, 24 that will do. 25 DR BUSBY: Now we go back to Tsuda. So the increase in --</p> <p style="text-align: center;">Page 17</p>	<p>1 recently. 2 DR BUSBY: I'm sure there are. 3 Also you said you had no possible doubt about the 4 proposition that those thyroid cancers -- or not thyroid 5 cancers but that there is a possibility of an increase 6 in thyroid cancer following Fukushima because you say 7 the dose is too low? 8 A. Yes, and actually the second results of the survey are 9 now out and they show a decrease, which is entirely what 10 we would expect because this was a screening artefact. 11 We do screen for mammary cancer to make sure we pick up 12 tumours earlier so this screening effect is not unknown 13 for other tumour types for other reasons. 14 Q. Was there not a screening -- Professor Tsuda here says 15 they screened for thyroid cancer shortly after the 16 accident, two years after the accident? 17 A. They staged the screening, because it's a large amount 18 of work to do this and you have to be especially trained 19 to use the equipment and to interpret things, so they 20 staged the screening, they started two years afterwards 21 and it took about two years to screen those who were 22 willing to come forward for screening. Many people have 23 moved away from the area and actually don't want to come 24 forward for screening. 25 Q. They found nothing?</p> <p style="text-align: center;">Page 19</p>
<p>1 according to Professor Tsuda -- was 50 fold. He said so 2 in the abstract. Do you agree with that? 3 A. No, he says it in the abstract. I don't agree with his 4 finding. 5 Q. That is what was found -- all I am saying is that was 6 found in the survey. So -- 7 A. That was his conclusion from analysing the data which is 8 actually public data. He's not a member of the people 9 who are doing the Fukushima health management survey and 10 I suspect this data was taken off the Fukushima Medical 11 University website where they make all of their data 12 available. 13 Q. Thank you. So your position then, just to summarise, is 14 that neither the increase -- that the increase in 15 Fukushima from thyroid cancer could not have been caused 16 by the exposure because the dose was too low? 17 A. Yes, and it's solely due to screening. 18 MR JUSTICE BLAKE: She is disagreeing with the proposition 19 that there is an increase. 20 A. Absolutely. There is no increase. 21 MR JUSTICE BLAKE: She says it is earlier detection. Come 22 on, we've had that answer, so you can't slip under the 23 cover there, I'm afraid. 24 A. I think you'll find there are several other people who 25 agree with that stance, published in The Lancet very</p> <p style="text-align: center;">Page 18</p>	<p>1 A. I didn't say they found nothing. They found 2 an incidence of thyroid cancer which is exactly where we 3 would estimate it would be from other control studies. 4 Q. I don't think I can take this one any further. Thank 5 you very much for that. We'll move on and we'll move 6 now back to the uranium paper which I showed you. 7 That's SB7/101. The uranium paper written by Alexander 8 Miller. 9 MR JUSTICE BLAKE: Can we put SB6 away or do you want to 10 come back to it? 11 DR BUSBY: Yes, we have finished with thyroid cancer, 12 my Lord. 13 MR JUSTICE BLAKE: Thank you. 14 DR BUSBY: This a paper called "Depleted uranium catalyzed 15 oxidative DNA damage: absence of significant alpha 16 particle decay". 17 MR JUSTICE BLAKE: Just remind me of the tab. 18 DR BUSBY: It was SB7/101. 19 MR JUSTICE BLAKE: 101, thank you. 20 DR BUSBY: Previously it was just an abstract. 21 MR JUSTICE BLAKE: Yes, right, so we can slip this in there. 22 DR BUSBY: So I think it might be easier, Professor Thomas, 23 if we just looked at the abstract. 24 A. I want to make some comments about the methodology as 25 well.</p> <p style="text-align: center;">Page 20</p>

5 (Pages 17 to 20)

<p>1 Q. Of course, of course.</p> <p>2 MR JUSTICE BLAKE: We have the abstract at the head of the</p> <p>3 paper. If we turn to the actual thing you put in last</p> <p>4 night, Dr Busby, the abstract at the head of the paper</p> <p>5 is the same as the document that was formerly in the</p> <p>6 bundle?</p> <p>7 DR BUSBY: It's the document that was presented last night</p> <p>8 and has now been printed and put in with the abstract.</p> <p>9 MR JUSTICE BLAKE: Right. If you want to draw the attention</p> <p>10 of this witness to a statement in the abstract, now that</p> <p>11 she's seen the paper she can give you an answer.</p> <p>12 DR BUSBY: It's a very simple question. Do you agree that</p> <p>13 this paper shows that uranium seems to have</p> <p>14 an anomalously high genotoxicity in this study?</p> <p>15 A. I don't think it's anomalously high. I think it's more</p> <p>16 or less what we would have expected from a high --</p> <p>17 a heavy metal like this. It's interesting they used</p> <p>18 depleted uranium. I would have liked to see a control</p> <p>19 where they used stable uranium and then you could have</p> <p>20 a handle on whether it was related to the radiation or</p> <p>21 whether it was related to --</p> <p>22 MR JUSTICE BLAKE: Slow down.</p> <p>23 A. Sorry. This, to me, is straight metal ion toxicity,</p> <p>24 which you would predict, which we know heavy metals are</p> <p>25 genotoxic. It has a relationship with dose, which we</p> <p style="text-align: center;">Page 21</p>	<p>1 to -- because I'm a bit confused about this concept of</p> <p>2 stable uranium, Professor Thomas, so could we see SB --</p> <p>3 let's see, what is it? -- SB6/73.</p> <p>4 A. Could you tell me the ...?</p> <p>5 Q. SB6/73.</p> <p>6 A. So not one of the new papers last night.</p> <p>7 MR JUSTICE BLAKE: No, we are going back --</p> <p>8 A. SB6/73.</p> <p>9 DR BUSBY: We need to look at that as well whilst we have</p> <p>10 this one open as well.</p> <p>11 A. This is just a list of decay tables; correct?</p> <p>12 Q. Correct. Correct.</p> <p>13 Now, I thought it might be useful for the Tribunal</p> <p>14 to have a list of the uranium isotopes that exist in</p> <p>15 nature, natural uranium isotopes. I wondered if you</p> <p>16 would tell us which of these isotopes you consider to be</p> <p>17 stable uranium?</p> <p>18 A. You don't have a decay table where there is a stable</p> <p>19 isotope because it does not decay.</p> <p>20 Q. I see. But actually may I put it to you that there is</p> <p>21 no such thing as stable uranium?</p> <p>22 A. I think you probably need to check that because I think</p> <p>23 that is untrue.</p> <p>24 Q. Right.</p> <p>25 A. So every single chemical element has a stable isotope.</p> <p style="text-align: center;">Page 23</p>
<p>1 would also predict. I think if I was looking for an</p> <p>2 effect that separated alpha from the effects of the</p> <p>3 general genotoxicity of uranium I would have liked to</p> <p>4 see a controlled platform that used stable uranium in</p> <p>5 the same doses. Then you could say whether depleted</p> <p>6 uranium, which is the subject of this, has a different</p> <p>7 toxicity from that you observe from stable uranium.</p> <p>8 MR JUSTICE BLAKE: Right. Just for my benefit, at least,</p> <p>9 I am getting the following summary answers; tell me if</p> <p>10 this is an over-crude simplification.</p> <p>11 (1) the results recorded in this article you do not</p> <p>12 consider to be anomalously high?</p> <p>13 A. No.</p> <p>14 MR JUSTICE BLAKE: (2) you consider it to be a study of</p> <p>15 metallurgy?</p> <p>16 A. Yes.</p> <p>17 MR JUSTICE BLAKE: And (3) you would have preferred to have</p> <p>18 seen a comparison between depleted and stable uranium?</p> <p>19 A. Yes, because that would given you the answer as to</p> <p>20 whether the depleted uranium was worse than normal</p> <p>21 uranium.</p> <p>22 MR JUSTICE BLAKE: Is there any other part of your answer</p> <p>23 that I missed out?</p> <p>24 A. No, that's absolutely fine, my Lord.</p> <p>25 DR BUSBY: We'll stay with this now but I want to take you</p> <p style="text-align: center;">Page 22</p>	<p>1 Q. All uranium is radioactive, Professor --</p> <p>2 MR JUSTICE BLAKE: You can't give evidence.</p> <p>3 A. It doesn't state that in any of the papers I read.</p> <p>4 MR JUSTICE BLAKE: Put a question and we'll get an answer.</p> <p>5 I think we have a disagreement with the proposition that</p> <p>6 there is no such thing as stable uranium.</p> <p>7 DR BUSBY: That's as far as I need to go; there's no such</p> <p>8 thing as stable uranium.</p> <p>9 So you are saying that this table from the federal</p> <p>10 agency is actually -- it omits stable uranium because</p> <p>11 it's not radioactive?</p> <p>12 A. I would probably need to check that. If you are adamant</p> <p>13 I can quite happily check that but I don't have the</p> <p>14 information here.</p> <p>15 Q. It might be wise.</p> <p>16 A. In any case it has an extremely long half life.</p> <p>17 Q. Well, that's a different point.</p> <p>18 MR JUSTICE BLAKE: Please can we have questions rather than</p> <p>19 two speeches.</p> <p>20 DR BUSBY: Yes, my Lord.</p> <p>21 So may we go back to the depleted uranium catalysed</p> <p>22 oxidated paper we were just looking at?</p> <p>23 A. Just a second. I am going to have to get that back out</p> <p>24 again.</p> <p>25 Q. Sorry.</p> <p style="text-align: center;">Page 24</p>

<p>1 MR JUSTICE BLAKE: I know we may have to jump around, but --</p> <p>2 DR BUSBY: I thought --</p> <p>3 A. Which bundle was that?</p> <p>4 MR JUSTICE BLAKE: We are back to 7, I think, tab 101.</p> <p>5 I think our visit to 6 was simply to examine whether you</p> <p>6 are right when you say that there is such a thing as</p> <p>7 stable uranium.</p> <p>8 DR BUSBY: We can put that to another expert.</p> <p>9 MR JUSTICE BLAKE: I happen to have read part of this paper</p> <p>10 this morning, although I don't pretend to understand it,</p> <p>11 but the phrase used here is "natural uranium". Is that</p> <p>12 different from stable uranium?</p> <p>13 A. That's what I understood to be stable uranium, but, my</p> <p>14 Lord, I will happily check and if I am wrong I will</p> <p>15 admit it.</p> <p>16 MR JUSTICE BLAKE: For the purposes of myself following the</p> <p>17 answers -- I know others will be much better informed --</p> <p>18 would you agree that what you refer to as "stable</p> <p>19 uranium" might be referred to as "natural uranium"?</p> <p>20 A. Yes.</p> <p>21 MR JUSTICE BLAKE: So at least we have that is the issue.</p> <p>22 A. The natural uranium will be a different isotope, that is</p> <p>23 for sure. I would need to check whether it would be</p> <p>24 stable in terms of it does not admit irradiation of any</p> <p>25 type over any half life.</p> <p style="text-align: center;">Page 25</p>	<p>1 would it be possible that this heavy metal effect that</p> <p>2 you're talking about that has been found by</p> <p>3 Professor Miller might have caused genetic damage to the</p> <p>4 veterans?</p> <p>5 A. I would think it was vanishingly unlikely and I'll</p> <p>6 explain why. These are in vitro studies, where you have</p> <p>7 dissolved something in water and you have done the</p> <p>8 experiment in vitro. As we discussed at length</p> <p>9 yesterday, many forms of uranium are insoluble. If you</p> <p>10 take in a particular dose of uranium most of it is</p> <p>11 excreted, so the amount that gets to your cells in vivo</p> <p>12 as opposed to an in vitro assay is markedly different</p> <p>13 and if you don't take that into account then you don't</p> <p>14 understand the difference between in vitro and in vivo</p> <p>15 experiments, which is critical.</p> <p>16 Q. Of course, but I think we agreed or you agreed that it</p> <p>17 was possible that some uranium could get to the DNA --</p> <p>18 A. In very small quantities.</p> <p>19 Q. In very small quantities, yes. Let's say that that</p> <p>20 uranium, the very small quantity as you put it that gets</p> <p>21 to the DNA might have -- if it were stable uranium as</p> <p>22 you say she is using here IT might have a genetic effect</p> <p>23 that is mediated through chemical genotoxicity?</p> <p>24 A. I would think at the doses that it is likely to reach</p> <p>25 the cells it would be vanishingly small.</p> <p style="text-align: center;">Page 27</p>
<p>1 DR BUSBY: Right, good.</p> <p>2 Well, all I want you to go to here is that you have</p> <p>3 said that you believe that what Professor Miller has</p> <p>4 found here is a heavy metal effect?</p> <p>5 A. Yes.</p> <p>6 Q. Right. So if people were exposed to uranium at</p> <p>7 Christmas Island you think that it's possible that they</p> <p>8 might have received the same sort of genetic damage as</p> <p>9 Professor Miller is finding here, but from a heavy metal</p> <p>10 effect?</p> <p>11 A. No, because it depends on the concentration again. You</p> <p>12 keep forgetting that there are differences in</p> <p>13 concentration and different concentrations, i.e. doses</p> <p>14 in this case, have different effects. I can quote you</p> <p>15 the actual human daily intake of uranium in the</p> <p>16 United States. It's 1.5 micrograms per day. So</p> <p>17 everybody is exposed to uranium and you cannot avoid</p> <p>18 that. There's some areas of the world will have</p> <p>19 slightly higher depending on their geology.</p> <p>20 Q. Quite, but that wasn't my question. My question is: if</p> <p>21 they were exposed to stable uranium -- what you call</p> <p>22 stable uranium -- from the bomb that Professor Sawada</p> <p>23 was talking about, the particles that were coming down</p> <p>24 from the bomb, if all of that was so, and I agree maybe</p> <p>25 you may not think that's possible, but if it happened</p> <p style="text-align: center;">Page 26</p>	<p>1 Q. But finite?</p> <p>2 A. I don't know what you mean by "finite".</p> <p>3 Q. Well, it would be more than zero?</p> <p>4 MR JUSTICE BLAKE: Measurable?</p> <p>5 A. Well, in that case we're all suffering from that because</p> <p>6 we all intake uranium, so we must have mechanisms that</p> <p>7 surely protect our bodies from things like that,</p> <p>8 otherwise we'd all be suffering the consequences.</p> <p>9 Q. Well, we all die, don't we, Professor?</p> <p>10 A. Sadly.</p> <p>11 Q. Yes.</p> <p>12 A. But that doesn't mean it was due to uranium.</p> <p>13 Q. I think that's as far as -- well, actually no, it's not</p> <p>14 as far as I can take it. I need to go forward with this</p> <p>15 one now. Let me see. Yes, we are going to put</p> <p>16 Professor Miller away now and we are going to go to</p> <p>17 SB6/87.</p> <p>18 A. A paper by Craft, yes?</p> <p>19 Q. This is a review article on the effects of uranium. We</p> <p>20 are going to go to the section on --</p> <p>21 A. I have not read this paper so forgive me if I have to</p> <p>22 stop and read some of it.</p> <p>23 Q. Well, in that case it's probably a bit unfair to ask you</p> <p>24 questions about it and I'm aware of the time constraints</p> <p>25 and I have a lot of other things to ask about. But</p> <p style="text-align: center;">Page 28</p>

<p>1 effectively this paper -- if I could summarise it -- you 2 may want to have a look at it. If you want 10 minutes 3 to read it -- 4 MR JUSTICE BLAKE: Are you in the same position? (Pause) 5 One of us has the paper; two of us have the 6 abstract. We'll try and catch up on that. 7 DR BUSBY: Right, well, in that case since there is rather 8 a lot of it, would you accept the proposition -- this 9 a question -- would you accept the proposition that this 10 paper reviews a lot of evidence that depleted and 11 natural uranium have significant health effects? 12 A. Actually, no, I disagree with that because on several of 13 the paragraphs I've just quickly looked at now: 14 "Animal studies also indicated no adverse 15 cardiovascular effects following oral inhalation 16 exposure to uranium." 17 I'd have to read this -- 18 Q. It's unfair to spring it on you and -- 19 A. Also I note that it's mainly animal and as I've said 20 before, using animal studies to predict human toxicology 21 is fraught with difficulties. 22 Q. So can we now go, therefore -- we'll put that to one 23 side and we'll go to the paper by Irena Guseva Canu and 24 I think a lot of other workers from the French nuclear 25 industry.</p> <p style="text-align: center;">Page 29</p>	<p>1 MR HEPPINSTALL: I can't reach mine but whatever the next 2 tab number is in 22. 3 DR BUSBY: Well, I won't go to more than just the abstract 4 here. This was a study that was done of a lot of French 5 nuclear workers who worked only on uranium so the 6 exposure -- a lot of the evidence in this case is 7 about external radiation. Would you agree? 8 A. External and internal. I think if you read the rest of 9 the paper she does actually state there is quite 10 a considerable internal radiation as well because she 11 talks about cardiovascular effects, lung effects, bone 12 effects. Yes, it's not just external, I think you'll 13 find. 14 Q. This is primarily a study of people whose exposure was 15 to uranium. Do you agree? 16 A. Yes, but that doesn't necessarily mean it's external 17 because uranium millers will actually take in uranium 18 dust as well. 19 Q. I think that's the point, Professor Thomas. We're 20 talking about internal, they're taking in uranium -- 21 A. Sorry, I thought you said external. I apologise. 22 Q. All we need to note from this, if I can read it to you, 23 it says: 24 "Workers occupationally exposed to uranium [this is 25 from the abstract about halfway down] appear to be at</p> <p style="text-align: center;">Page 31</p>
<p>1 A. Yes, I know -- 2 Q. SB6/84. 3 MR JUSTICE BLAKE: So the same bundle back to 84, is it? 4 A. No, it's one of the papers which came in overnight, 5 my Lord. 6 MR JUSTICE BLAKE: Oh right. 7 DR BUSBY: I think this is ... no, that's not the right one. 8 MR JUSTICE BLAKE: Where do we put this? Which tab? 9 MS BUSBY: It's a new paper, my Lord. 10 MR JUSTICE BLAKE: I have the paper. Which tab? 11 MS BUSBY: It doesn't have a tab. 12 MR JUSTICE BLAKE: I thought this was an expansion of the 13 abstract. 14 MS BUSBY: No, it was given to the -- last night. 15 MR JUSTICE BLAKE: Yes. So this might be a candidate for 16 22. (Pause) 17 DR BUSBY: Do you have a copy of this, my Lord? 18 MR JUSTICE BLAKE: "Cancer risk in nuclear workers." Yes, 19 thank you. 20 DR BUSBY: Okay, thank you. 21 MR JUSTICE BLAKE: Could we put this behind tab 6? Because 22 that tab 6 is papers that Dr Busby is handing up. 23 MR HEPPINSTALL: Yes, or I think maybe a new tab I would 24 recommend in SB22. 25 DR BUSBY: So everyone has a copy in their hand.</p> <p style="text-align: center;">Page 30</p>	<p>1 increased risk of mortality ...(Reading to the words)... 2 and inaccurate assessment of internal exposure." 3 Would you agree with that? 4 A. No, I don't because if you read the rest of the paper 5 she says in the conclusions the exact opposite. 6 MR JUSTICE BLAKE: Where does she say it the exact opposite? 7 A. If you look at "In conclusion", the first paragraph at 8 the bottom of page 13. 9 MR JUSTICE BLAKE: Right. Let's just move on to there. 10 Yes. 11 A. There's an interesting use of English here. 12 MR JUSTICE BLAKE: Right. So you point to the passage 13 "conclusion", page 13? 14 A. Yes: 15 "Our review shows that in several cohorts of workers 16 with potential occupational exposure to uranium cancer 17 mortality risk was increased non-significantly." 18 Now, I do not like people who put things in that 19 term. In science you do studies that show either 20 a significant increase or they do not show a significant 21 increase. 22 MR JUSTICE BLAKE: So -- 23 A. It's not a significant increase, so therefore there is 24 no effect. If you go through -- 25 MR JUSTICE BLAKE: Well, what does the next sentence mean?</p> <p style="text-align: center;">Page 32</p>

8 (Pages 29 to 32)

<p>1 A. "Among 18 cohorts, a few studies presented a significant 2 excess of a priori suspected sites." 3 If you read the paper further, it also tells you 4 that these workers were exposed to things like silica 5 and vanadium. In the early years of the industry the 6 health -- people didn't really take that much notice of 7 compliance with health regulations and so a lot of dust 8 was -- these workers were exposed to a lot of dust and 9 she points out under the respiratory system on page 4 in 10 the middle of that paragraph: 11 "The increase was significant among men ..." 12 MR JUSTICE BLAKE: Sorry I am plodding my way through rather 13 later, I am sorry. Yes, I'm now there. 14 A. "The increase was significant among men who began work 15 before 1955 when exposures to uranium, silica and 16 vanadium were presumed to be high. The role of other 17 chemical exposures and of tobacco was not assessed as 18 data were lacking." 19 That's really important you assess that when you are 20 looking at respiratory effects. 21 MR JUSTICE BLAKE: "Hence this study is rather inconclusive 22 with respect to the association between lung cancer 23 mortality and internal exposure to uranium during 24 milling." 25 A. Yes.</p> <p style="text-align: center;">Page 33</p>	<p>1 relationships with internal radiation dose ..." 2 A. Sorry, I can't see where you are. Okay, I've got it. 3 Q. The last line but one starts: 4 "Statistically significant dose response 5 relationships with internal ...(Reading to the words)... 6 and upper area digestive tract." 7 A. But I think from her conclusions you can see she is not 8 looking at just two studies, she is looking at the body 9 of data and when you are looking for a small effect by 10 pure chance you will find it in some studies and not in 11 others. So you don't know whether that is genuine and 12 that's a big problem with these studies. 13 MR JUSTICE BLAKE: As I read that sentence, forgive me if 14 I've misunderstood, it wasn't referring to two studies 15 but reports on two sites. 16 A. And she cites one paper, which is one study. 17 MR JUSTICE BLAKE: Right, so it's one study on two sites. 18 Do you know that paper -- 19 A. I don't I'm afraid, my Lord, and I didn't have time to 20 look at the references. 21 MR JUSTICE BLAKE: I am not suggesting you should have done, 22 I am just asking the question. 23 A. But the general consensus is that there is no, what we 24 would regard in science as scientific evidence of 25 an effect of uranium and that's a general consensus from</p> <p style="text-align: center;">Page 35</p>
<p>1 MR JUSTICE BLAKE: All right. 2 A. Again, if you look further there are other evidences of 3 that. Just to take you to the last paragraph of the 4 paper, "Future directions" on page 14. 5 MR JUSTICE BLAKE: "Future directions", yes. 6 A. It says: 7 "Although a substantial body of epidemiologic 8 ...(Reading to the words)... alpha particles from 9 uranium was very limited." 10 So I think the conclusions from this paper are very 11 different from that stated in the abstract and that was 12 my point yesterday when I refused to review a paper 13 solely on the abstract. The abstract is what gets your 14 paper published and if you present something that looks 15 positive it's much more likely to get published. That's 16 why abstracts should never be taken out of context. 17 MR JUSTICE BLAKE: Well, you got an answer. 18 DR BUSBY: Yes. I have a question, can I read to you from 19 the -- whilst we are dissecting this paper, I think the 20 point of this paper here is in the conclusion. 21 A. Yes. 22 Q. At the bottom of the left-hand column of page 13 -- 23 MR JUSTICE BLAKE: Yes. 24 DR BUSBY: -- you can see it says, and I'll read it: 25 "Statistically significant dose response</p> <p style="text-align: center;">Page 34</p>	<p>1 many different sources. 2 MR JUSTICE BLAKE: Even in lymphatic and haemopoietic 3 sites? 4 A. Yes. The other thing you need to be aware of when 5 you're looking at this sort of information, my Lord, is 6 many of these studies have workers that were exposed to 7 much higher levels than we would find now, so you have 8 a cohort exposed to higher levels but in the generality 9 most of the workers were exposed to much lower doses 10 because of changes in health and safety. That doesn't 11 just go for uranium, it goes for all the other 12 particulates that they are exposed to. 13 MR JUSTICE BLAKE: Pause there. Dr Busby will ask any 14 further questions on this paper that he thinks are 15 appropriate. 16 DR BUSBY: Only one question, my Lord. The question is: do 17 you think that the evidence reviewed in this paper 18 persuades you that there may be an excess risk from 19 exposure to internal uranium at low doses? 20 A. I think it is impossible to say there is no risk. As 21 I said earlier yesterday in response to Mr ter Haar it 22 is extremely difficult to say nothing has no risk, it's 23 just a question of how small that risk is, and when you 24 compare that risk with other risk factors that produce 25 that same disease is it a risk that you should taking</p> <p style="text-align: center;">Page 36</p>

<p>1 into account? Or is it an irrelevance so that you 2 forget the other risks that create that disease? 3 Q. Thank you. 4 MR JUSTICE BLAKE: Is irrelevance a scientific measured -- 5 A. No, I think, my Lord, what you would say if the risk is 6 infinitesimally small you focus on protecting the 7 workforce from that single risk, you have to make sure 8 that in doing that you do not produce more risks because 9 you are so focused on that one risk. I can give you 10 a very good example of that in Fukushima. They are so 11 focused on protecting the workers from the radiation 12 risk they make them wear full body suits in 40 degrees 13 of heat and several Japanese workers there have died of 14 a heart attack and heat stroke because they were so 15 focused on that single risk. 16 MR JUSTICE BLAKE: Fortunately our task is not going to be 17 to devise a health and safety regime to eliminate the 18 risks from uranium. We have to focus our minds upon 19 a causation issue. I was just wondering whether you 20 were going to be lured into "infinitesimally small" 21 as having a statistical meaning. 22 A. Well, if you can't see it statistically then it is so 23 small that it becomes an irrelevant risk. That is our 24 general scientific understanding of something that is 25 not significant, it is infinitesimally small -- so small</p> <p style="text-align: center;">Page 37</p>	<p>1 A. I'm afraid all of our science is based on something that 2 is significant. If it is not significant it's not 3 something we will go back -- 4 Q. You mean it's not statistically significant? 5 A. Yes. Well, I don't know there's any other form of 6 significant that we would accept in science I'm afraid. 7 Q. Of course. But this Tribunal may not understand that 8 there is a difference, that you could have an increase 9 which is in fact representative of something real, but 10 it might not be statistically significant -- 11 A. But it isn't real in the general population. 12 Q. -- because the numbers are too small. 13 A. That means your study needs to be done again. That 14 means you can't define the risk because your study may 15 be very misleading and I hate to say an awful lot of the 16 studies in this area are too small to have statistical 17 significance. 18 Q. Let's look at one that does. SB7/124. This is another 19 one of the abstracts -- so we have the abstract at 20 SB7/124. We don't seem to have the paper that we sent 21 in last night. 22 A. I have it in my bundle. 23 Q. You have it, yes. 24 25 A. This is a paper by Zaire, is that right?</p> <p style="text-align: center;">Page 39</p>
<p>1 that we can't detect it. 2 MR JUSTICE BLAKE: If you can detect it? 3 A. If you can reliably detect it -- and I'm afraid when you 4 do human studies you can be misled. 5 MR JUSTICE BLAKE: If you can reliably detect it? 6 A. If you can reliably detect it, you need to take it into 7 account and then you can decide whether it is a risk 8 that in the general pool of risks that affect your 9 health it is something that needs to be taken account 10 of. 11 MR JUSTICE BLAKE: Right. 12 DR BUSBY: Whilst you were talking about that paper, 13 Professor Thomas, you mentioned that non-significant 14 increase, and you talked about the idea of a significant 15 increase and a non-significant increase. Could you 16 distinguish between an increase which is not 17 statistically significant and a non-significant 18 increase? 19 A. It depends on the P value as to whether something is 20 statistically increased or not, which I'm sure you're 21 aware of. And it will depend on the study design, the 22 numbers, and I'm not a statistician but you will be 23 talking to a statistician later and I'm sure he can give 24 you a much more concise definition. 25 Q. I will, thank you.</p> <p style="text-align: center;">Page 38</p>	<p>1 Q. This is the paper about chromosome aberrations in 2 uranium miners. 3 A. Yes. 4 Q. Well, I don't have the paper in front of me. But going 5 from the -- has everybody got it? 6 DR RAYNER: No, we just have the abstract. I think it's 7 coming. (Handed) 8 MR JUSTICE BLAKE: Right. Which tab? 9 DR BUSBY: This was a study of uranium miners in which the 10 uranium was measured in uranium excretion in the urine. 11 So they knew how much uranium was in these people -- 12 A. It was a cohort of 14 miners and 6 controls. Only 14 13 miners had the uranium concentration in the urine 14 examined. So again a small sample size. 15 Q. Well, yes, a small sample size but if we go halfway down 16 the abstract, and I'm sure we can find this in the paper 17 as well because they can't make it up, they say: 18 "A sixfold increase in uranium excretion was 19 recorded." 20 And if we go a bit further, then various other 21 things were found too -- testosterone levels, neutrophil 22 count, and so forth. You see all of those things say "P 23 value of ..." -- if we say a sixfold increase in uranium 24 excretion the P value is 0.001. 25 Then the reduction in testosterone was 0.008,</p> <p style="text-align: center;">Page 40</p>

1 neutrophil count 0.004. But the thing I really want to
 2 draw attention is to a threefold increase in chromosome
 3 aberrations in the miners compared to non-exposed
 4 controls?
 5 **A. I'm sorry, with numbers this small this would need to be**
 6 **validated in a separate cohort. This is not good**
 7 **science.**
 8 Q. Why?
 9 **A. Because the numbers of people you've looked at is so**
 10 **small. You have a huge sampling problem there. You**
 11 **could have literally by accident sampled a particularly**
 12 **high population. This is not acceptable as good**
 13 **science.**
 14 Q. What does it mean, a P value of 0.0001?
 15 **A. P values, unless you know the sample size you are**
 16 **dealing with can be very misleading, and I'm afraid most**
 17 **people do not look at the statistics properly and there**
 18 **is little statistical advice in peer review. Some**
 19 **journals are now insisting on it because they're aware**
 20 **of things like this, where it looks good on the table,**
 21 **and that's what most people will read, but when you look**
 22 **at the number of people you studied you realise it's**
 23 **such a small population that it is highly suspect as**
 24 **a genuine P value that represents the population.**
 25 **I'm sure you can take that further with Dr Haylock.**

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1 MR JUSTICE BLAKE: Can I just check that I have your answer
 2 to the question. I think you are being asked to comment
 3 on upon the conclusion in the abstract of a threefold
 4 increase in chromosome aberrations and your answer is
 5 the sampling process was too small --
 6 **A. Yes.**
 7 MR JUSTICE BLAKE: -- for reliable conclusions of that sort
 8 to --
 9 **A. If we relied on information like this to make medical**
 10 **decisions we'd be shot and rightly end up in court.**
 11 MR JUSTICE BLAKE: So it's too small.
 12 **A. Yes, it's too small to be able to draw secure**
 13 **conclusions about the population from which it is**
 14 **derived.**
 15 MR JUSTICE BLAKE: So if you are presented with information
 16 of such a medical finding and you were curious to know
 17 more as to whether the proposition was correct, what
 18 would you need to do?
 19 **A. You'd fund a bigger study. You would need to find --**
 20 **you could do it two ways. You can choose a bigger study**
 21 **with the same cohort, or even better, which is what we**
 22 **insist on when we do medical research into drugs is you**
 23 **choose another cohort and repeat the study then look for**
 24 **the biomarker in question.**
 25 **DR BUSBY: Professor Thomas, a P value of 0.0001 is given in**

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1 **order to discount the possibility that this occurred by**
 2 **chance. Is that right?**
 3 **A. That's what people generally think it is but actually**
 4 **that's when people don't understand statistics, because**
 5 **the population size from which that P value is drawn to**
 6 **know whether that might be representative of a larger**
 7 **population is extremely important. And again I'm afraid**
 8 **it shows that you should not just read abstracts. You**
 9 **must read the rest of the paper to look at sample sizes**
 10 **and things like that.**
 11 Q. It does say that in the actual paper though?
 12 **A. It does say what?**
 13 Q. It says that the P value is 0.0001.
 14 **A. I don't care what it says about the P value. I'm**
 15 **telling you the study is badly designed, and I'm sorry,**
 16 **you shouldn't be drawing conclusions from badly designed**
 17 **studies.**
 18 Q. Is it true to say that a P value of 0.0001 means it
 19 couldn't have occurred by chance except 1 in 10,000
 20 times? Is that what a P value means?
 21 **A. It says it couldn't have occurred by chance with the**
 22 **design that you have used but if that design is not**
 23 **suitable to test your hypothesis then it doesn't tell**
 24 **you anything.**
 25 Q. But these people took uranium miners and studied --

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1 **A. They studied 75 miners. That is not statistically**
 2 **useful. I'm sorry. In medicine -- the human body is**
 3 **infinitely variable. You can't just select 75 and**
 4 **assume that's representative of a much larger number.**
 5 **It's wrong.**
 6 Q. I'll have to leave that one. I can't go any further
 7 with it.
 8 **A. Talk to Dr Haylock. I am sure he is going to be better**
 9 **qualified to give you chapter and verse than I am on**
 10 **that.**
 11 Q. Dr Haylock will do that.
 12 So far we've had several pieces of evidence that
 13 I suggested show that uranium has effects on chromosome
 14 damage and on cancer so we're now going to another.
 15 **A. In your opinion, not in mine.**
 16 Q. We're now going to see another one. It's at SB7/119.
 17 **A. You will remember, of course, Dr Busby that I was asked**
 18 **to look at the radiogenic nature of this, not the**
 19 **genotoxicity.**
 20 Q. We would argue it's the same, Professor Thomas, it's
 21 only you that says that it's chemical.
 22 **A. I'm sorry, the two things are slightly different. One**
 23 **is genotoxicity caused by a chemical issue and the other**
 24 **one is caused by radiation. My estimations were based**
 25 **on radiation dose. I was not given information about**

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<p>1 the uranium that might or might not be found in these 2 people. 3 Q. But you read our papers? 4 A. I read your papers but I didn't have any information to 5 work on that gave me individual dose amounts for uranium 6 in those people. 7 Q. No, we don't have those. 8 MR JUSTICE BLAKE: Please, we have to ask questions. 119? 9 DR BUSBY: Yes. 10 A. 119? 11 MR JUSTICE BLAKE: It's an abstract. 12 DR BUSBY: Well, we have provided the paper, my Lord. 13 A. I do have the paper here. 14 Q. "Chromosome aberration analysis in peripheral 15 lymphocytes of Gulf War and Balkans War veterans". 16 A. I think we can go -- I don't think I need the question, 17 Dr Busby. If you look at the abstract, 13 British Gulf 18 War veterans, that was their sample size. That is not 19 sufficient to draw viable statistical conclusions on. 20 Q. I haven't asked you a question yet, Professor Thomas. 21 MR JUSTICE BLAKE: All right. Ask the question, please. 22 DR BUSBY: The question is: this paper describes a study of 23 chromosome aberrations in Gulf War veterans who were 24 exposed to uranium and they measured the uranium in 25 urine, and found a significant excess of chromosome</p> <p style="text-align: center;">Page 45</p>	<p>1 received three papers last night. Canu, Miller and 2 "Mortality and Morbidity". Some of them we got twice. 3 DR BUSBY: Well, we can rectify that, my Lord. 4 MR JUSTICE BLAKE: Thank you. 5 DR BUSBY: Professor Thomas, we have looked at a few papers 6 which show genetic effects in people exposed to uranium. 7 A. Mm-hm. 8 Q. And your position is that you discount those effects 9 because you say, despite the fact that they are 10 apparently statistically significant, the numbers 11 involved were too small for you to say that they were 12 worth -- 13 A. Representative of the population. 14 Q. Yes. Well, here is a paper about genetic effects in 15 Gulf War veterans and you can see the title says: 16 "A population-based survey of 30,000 veterans." 17 Would that be a large enough study to -- 18 A. Yes, but there is a slight problem with this which was 19 raised in respect of your paper with de Messieres. This 20 is a survey, a questionnaire-based project, and again 21 unless you validate the responses in the questionnaire 22 it is very difficult to be sure that what you are 23 looking at is genuine and you don't have a biosample. 24 MR JUSTICE BLAKE: Okay. 25 A. Again you haven't given me time to read this paper at</p> <p style="text-align: center;">Page 47</p>
<p>1 damage. Could you comment on it? 2 A. No, I can't because (a) I haven't read it and also as 3 soon as I read the abstract it would be something that 4 I would not regard as a useful paper to read that would 5 give me scientific value. 6 Q. Right. 7 A. 13 is not a big enough number. 8 Q. Right. So do you dismiss the -- 9 A. I dismiss irrelevant studies that are likely to be 10 misleading of a whole population. I'm sorry, I'm 11 a scientist and I'm trained to do that. 12 MR JUSTICE BLAKE: I think we have that point. Is there 13 anything else in the paper itself rather than the 14 abstract that you would like to put to Professor Thomas, 15 Dr Busby? 16 The answer is it's too small to make reliable -- 17 DR BUSBY: No, my Lord. I don't see any purpose in that. 18 She obviously has made her position clear on this study 19 and we can move on. 20 So we'll move on to SB7/98. 21 MR JUSTICE BLAKE: Yes. 22 DR BUSBY: Does everybody have that one? 23 MR JUSTICE BLAKE: I have the abstract, not the paper. 24 DR BUSBY: Ah right, okay. Well, the paper was submitted. 25 MR JUSTICE BLAKE: It didn't reach us last night. We</p> <p style="text-align: center;">Page 46</p>	<p>1 length. 2 MR JUSTICE BLAKE: Do you want to read it now or not? 3 A. No, I don't think it's worthwhile. 4 DR BUSBY: If you read down on the left-hand side the little 5 bit of blurb at the bottom where it says -- 6 A. I know it's come from a reputable journal. I can see 7 that but it doesn't mean that's right -- 8 DR BUSBY: I don't think we are talking about the journal 9 here. I was going to the fact that this was from the 10 Environmental Epidemiology Service of the Department of 11 Veterans Affairs, Washington DC. 12 A. Yes, I'm not saying that it is irrelevant. What I am 13 saying is there are basic problems with this design of 14 study and I can't -- if I look through, if you can point 15 me somewhere where they said they validated this. 16 MR JUSTICE BLAKE: Look, just pause there. Have you had 17 a chance to read this or not? 18 A. No, I haven't. 19 MR JUSTICE BLAKE: Right. So this -- 20 A. I haven't read every paper in the bundles, my Lord. 21 MR JUSTICE BLAKE: I imagine you were entitled to get some 22 sleep last night. 23 MR HEPPINSTALL: My Lord, there are two sets of papers 24 received by the Secretary of State. One was three 25 papers we passed on to Professor Thomas.</p> <p style="text-align: center;">Page 48</p>

<p>1 MR JUSTICE BLAKE: Quite.</p> <p>2 MR OSMAN: We then received a much larger number of</p> <p>3 papers --</p> <p>4 MR JUSTICE BLAKE: Well, it's too little, too late, I'm</p> <p>5 sorry. You were directed to provide all the papers last</p> <p>6 week and we made it plain last night that if you were</p> <p>7 going to ask questions of a witness she needed a chance</p> <p>8 to read it. Now, it's really -- I mean this is not</p> <p>9 effective cross-examination if you are introducing</p> <p>10 a whole paper at this stage in the game. How many more</p> <p>11 of these do you have up your sleeve, Dr Busby?</p> <p>12 DR BUSBY: Well, it's not up my sleeve, my Lord. We were</p> <p>13 asked to provide them last night and we provided them.</p> <p>14 MR JUSTICE BLAKE: Well, you failed to do so, so that's</p> <p>15 a failure because the person who needs it -- I think one</p> <p>16 of my colleagues has it in her pile but we haven't, but</p> <p>17 that doesn't really matter. I'm not concerned about</p> <p>18 myself, I'm concerned about the witness and it was not</p> <p>19 provided in time for her to read. Of course there we</p> <p>20 are. But I think if you want to show us the methodology</p> <p>21 of this paper, let's have a look at that, shall we?</p> <p>22 This is at page 2 under the heading "Methods".</p> <p>23 A. Yes.</p> <p>24 MR JUSTICE BLAKE: Do you just want to read that section to</p> <p>25 yourself?</p> <p style="text-align: center;">Page 49</p>	<p>1 MR JUSTICE BLAKE: Let's try to ensure that before you put</p> <p>2 any further papers which are not in the bundles as</p> <p>3 prepared to the witness that she has had notice of it.</p> <p>4 Yes? Otherwise we just don't --</p> <p>5 DR BUSBY: Yes, thank you, my Lord. We did actually send</p> <p>6 these in at 7.30 last night. But it takes a while --</p> <p>7 MR JUSTICE BLAKE: I am not going to debate that. I have</p> <p>8 e-mails which would demonstrate the contrary.</p> <p>9 (10.52 am)</p> <p>10 (A short break)</p> <p>11 (11.05 am)</p> <p>12 MR JUSTICE BLAKE: Right, have you had a chance to read two</p> <p>13 papers?</p> <p>14 A. I have read as quickly as I can. I would have liked</p> <p>15 longer, but I have the general gist. I am happy to</p> <p>16 answer questions on it.</p> <p>17 MR JUSTICE BLAKE: While you are here it would be helpful if</p> <p>18 you can help us.</p> <p>19 A. I will let you know when I get to the limit of my</p> <p>20 knowledge.</p> <p>21 MR JUSTICE BLAKE: You have had your apple, have you,</p> <p>22 Dr Busby?</p> <p>23 DR BUSBY: Yes, my Lord.</p> <p>24 MR JUSTICE BLAKE: Good. So where do we go now? 98 --</p> <p>25 DR BUSBY: I seem to have just mislaid the Kang paper.</p> <p style="text-align: center;">Page 51</p>
<p>1 A. Yes, it's interesting that they have 15,000 Gulf</p> <p>2 veterans --</p> <p>3 MR JUSTICE BLAKE: Just read it to yourself. If you want us</p> <p>4 to break for 20 minutes we can take a break now.</p> <p>5 DR BUSBY: I wouldn't mind a break, my Lord.</p> <p>6 A. That would be good, thank you.</p> <p>7 MR JUSTICE BLAKE: What I am anxious, however, is I am not</p> <p>8 going to be able to take a break every half hour.</p> <p>9 DR BUSBY: I was going to ask you if I could eat an apple.</p> <p>10 MR JUSTICE BLAKE: We'll take a break, you can eat an apple,</p> <p>11 you can read a paper, then we'll continue. It probably</p> <p>12 would be helpful, although I am not putting you in any</p> <p>13 handcuffs, just to have a sense if you could communicate</p> <p>14 with your colleagues how long your examination is likely</p> <p>15 to continue for because I know other people might be</p> <p>16 here today.</p> <p>17 DR BUSBY: Given we have a break now, and we come back say</p> <p>18 11 o'clock would be fine by me, then another hour --</p> <p>19 MR JUSTICE BLAKE: I will say 5 past 11. I am not asking</p> <p>20 you to do it now. Think about it, tell your colleagues</p> <p>21 and if you can tell me -- it's more just about managing</p> <p>22 today's events rather than anything else.</p> <p>23 DR BUSBY: Thank you, my Lord.</p> <p>24 MR JUSTICE BLAKE: If this is important material --</p> <p>25 DR BUSBY: Might I just say --</p> <p style="text-align: center;">Page 50</p>	<p>1 MR JUSTICE BLAKE: It should be at tab 98 of SB7, I believe.</p> <p>2 DR BUSBY: Thank you.</p> <p>3 Professor Thomas, here is another paper that</p> <p>4 suggests that there may be some problems with exposure</p> <p>5 to depleted uranium.</p> <p>6 A. I don't agree with your conclusion on that.</p> <p>7 Q. So this is not a paper that suggests --</p> <p>8 A. No, actually it says quite categorically in the</p> <p>9 conclusions:</p> <p>10 "A combination of genetic and environmental factors</p> <p>11 may contribute to 20 to 25 per cent of congenital</p> <p>12 abnormalities."</p> <p>13 So you'd have to bear in mind that this is not about</p> <p>14 depleted uranium, it's about exposure to a variety of</p> <p>15 different agents that the Gulf War veterans might have</p> <p>16 been exposed to. So I don't think it supports an</p> <p>17 argument about depleted uranium because it doesn't</p> <p>18 mention what the exposure was.</p> <p>19 Q. But the exposure included depleted uranium, you agree?</p> <p>20 A. We assume so. We are not told that in the paper and we</p> <p>21 are not told the extent of that.</p> <p>22 MR JUSTICE BLAKE: Can you just draw my attention, please,</p> <p>23 to the conclusion to which you have just referred?</p> <p>24 A. Yes, page 509, my Lord.</p> <p>25 MR JUSTICE BLAKE: 509, yes, thank you.</p> <p style="text-align: center;">Page 52</p>

1 **A. It's in the paragraph beginning "A third limitation of**
 2 **the study". They are very honest about the limitations.**
 3 MR JUSTICE BLAKE: The second column, yes.
 4 **A. Okay, and if you read a bit further down it states:**
 5 **"A combination of genetic and environmental factors**
 6 **may contribute to 20 to 25 per cent of congenital**
 7 **abnormalities."**
 8 MR JUSTICE BLAKE: Right.
 9 **A. If you follow that paragraph to its end it ends:**
 10 **"Certainly Gulf veterans were exposed to many**
 11 **chemical, biological and physical agents suspected of**
 12 **being reproductive toxins."**
 13 MR JUSTICE BLAKE: So (1) the conclusion is too ambiguous to
 14 be uranium-specific?
 15 **A. I think there is no proof in here it is uranium. There**
 16 **may well have been other exposures that have contributed**
 17 **to that and you'd have to dissect that.**
 18 MR JUSTICE BLAKE: You started before the break to say
 19 something about the sampling methods. Is that relevant
 20 to what you want to say or not?
 21 **A. No, I would say having reviewed the paper they have**
 22 **taken considerable pains to examine whether there might**
 23 **be a bias and how that might be addressed by this study,**
 24 **so they have taken that into account.**
 25 MR JUSTICE BLAKE: That is in the section "Methods"?

1 **A. That's in the -- yes, and it goes into quite**
 2 **considerable detail about allowing for various biases**
 3 **further on in the paper, my Lord. I can't find it**
 4 **exactly --**
 5 MR JUSTICE BLAKE: But if you are sampling veterans, there
 6 is a method of counteracting bias, is there?
 7 **A. Yes, they've taken account of the biases that may occur**
 8 **because of the methodology.**
 9 MR JUSTICE BLAKE: That's not an observation you would want
 10 to make of this paper?
 11 **A. No.**
 12 MR JUSTICE BLAKE: Rightly ho.
 13 **A. I would like to point out you may read the title and**
 14 **think it was 30,000 veterans who were exposed to these**
 15 **agents. Actually it's 15,000 veterans exposed and**
 16 **15,000 not deployed. So in other words the sample size**
 17 **is actually half what the title may have suggested to**
 18 **you.**
 19 MR JUSTICE BLAKE: I rather picked that up from the first
 20 line of the abstract. I looked at that round the
 21 title --
 22 **A. 15,000 is a substantial sample size.**
 23 MR JUSTICE BLAKE: Yes, good.
 24 DR BUSBY: Well, I don't think we have -- I have your answer
 25 on this. Can I ask you, do you think that this paper

1 suggests there may be an association between exposure to
 2 depleted uranium and the congenital malformations that
 3 they found? There may be?
 4 **A. It's possible but without controlling for the other**
 5 **things that we know do affect reproductive toxicity that**
 6 **we know other Gulf War veterans were exposed to you**
 7 **cannot say it was definitely due to depleted uranium.**
 8 **It was one of the factors that we know might be involved**
 9 **but you can't prove it from this paper because it**
 10 **doesn't have the evidence in here to prove it.**
 11 Q. Of course. Quite so.
 12 I think I now want to go to another paper of similar
 13 ilk, which is SB7/93.
 14 **A. This is the one by Araneta.**
 15 Q. This is Araneta. I mean there are a fair number of
 16 these papers. I just chose two just to make the point.
 17 There are a lot of papers where we see these increases
 18 in risk in Gulf War veterans. This is another one.
 19 Would you accept that this paper gives evidence for
 20 birth defect excess amongst the children born to Gulf
 21 War veterans in these states of the United States?
 22 **A. I wouldn't be that strong in my conclusion as the**
 23 **authors themselves actually state in the conclusion at**
 24 **the end, my Lord, on page 259.**
 25 MR JUSTICE BLAKE: Shall we just get there?

1 **A. Just above the acknowledgements, my Lord.**
 2 MR JUSTICE BLAKE: Yes, "conclusion".
 3 **A. "We did not, however, have the ability to determine if**
 4 **the excess was caused by inherited, environmental or**
 5 **synergistic factors or was due to chance."**
 6 **So the authors themselves actually state in their**
 7 **conclusions they do not feel that they can draw any**
 8 **conclusions about the causality of these effects being**
 9 **due to being in the Gulf War. That's not my conclusion,**
 10 **that's their conclusion.**
 11 MR JUSTICE BLAKE: Yes. So both these papers, as
 12 I understand it, are studies of US service personnel.
 13 **A. Yes.**
 14 MR JUSTICE BLAKE: Are they of the men or the women?
 15 **A. Some of them are both. Certainly the first paper looked**
 16 **at the women as well.**
 17 MR JUSTICE BLAKE: Because women's reproductive --
 18 **A. Yes.**
 19 MR JUSTICE BLAKE: -- DNA can be affected as much as the
 20 men.
 21 **A. Interestingly they didn't find the effects in the women.**
 22 **They found it in the men --**
 23 MR JUSTICE BLAKE: I thought the sperm -- I thought
 24 yesterday we were looking in particular at male
 25 contribution to reproduction as vulnerable.

1 **A. Yes.**
 2 MR JUSTICE BLAKE: But anyway, and are they finding some
 3 anomalous --
 4 **A. They are finding some anomalies which they cannot --**
 5 **they don't have the data to investigate further.**
 6 MR JUSTICE BLAKE: But at least it can be said there are
 7 anomalies in terms of birth defects.
 8 **A. Whether they are genuinely caused by exposure to**
 9 **depleted uranium or whatever the cause is it's not clear**
 10 **but there are slight changes. They're not big changes.**
 11 MR JUSTICE BLAKE: But in the larger paper, at least, there
 12 are anomalies which may be caused by a variety of
 13 exposures and even if it's exposures during military
 14 service, although relevant in some respects no doubt, if
 15 the issue we're looking at here is what is the
 16 particular contribution of uranium or depleted uranium
 17 they are unable to distinguish that particular factor as
 18 to other risk factors during that period of service?
 19 **A. Yes, or even actually general risk factors because we**
 20 **know genetics affects outcome.**
 21 MR JUSTICE BLAKE: I think I have that as well but I am just
 22 trying to absorb the information from the summaries. We
 23 are being told there were other factors in military
 24 service and other factors anyway in these informants'
 25 lives which might have affected the outcome?

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1 **A. Yes. There's one other point of note as well.**
 2 **I haven't had time to read the paper exhaustively but**
 3 **some of the conclusions are drawn from much smaller**
 4 **sample sizes. In the 15,000, for example, they looked**
 5 **at defect severity status, okay, to see whether it was**
 6 **a much worse defect in those who were exposed to who**
 7 **were not. Then they looked at a much smaller subgroup**
 8 **of infants, 125, so I think the data has to be read very**
 9 **carefully to be absolutely certain whether the sample**
 10 **sizes in the subgroups that they've analysed does give**
 11 **you statistical viability for drawing the conclusions.**
 12 **That's positive and negative as well.**
 13 MR JUSTICE BLAKE: Yes.
 14 **A. So only two -- if you look at the figures there, it**
 15 **gives you only two of the 125 infants had a reported**
 16 **birth defect in the control population versus 9 per cent**
 17 **overall. They've only looked at 125, I presume only in**
 18 **the control population, or no, they were conceived prior**
 19 **to the father's deployment to the Gulf.**
 20 **So again it's indicating there might have been**
 21 **something in their exposure in the Gulf but actually**
 22 **with low percentages like that to draw on a figure of**
 23 **125 you don't have the same statistical security that**
 24 **you would have had if it was all 15,000. So just a note**
 25 **of caution on some of the conclusions drawn.**

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1 MR JUSTICE BLAKE: Yes.
 2 **A. I am not saying they are wrong but they need to be**
 3 **interpreted correctly.**
 4 **DR BUSBY: Professor Thomas, you agree with me that this**
 5 **study came from the Department of Defense, Center for**
 6 **Deployment Health Research Naval Health Research Center,**
 7 **San Diego?**
 8 **A. Yes.**
 9 Q. This is an authoritative study, is it not?
 10 **A. Yes.**
 11 Q. It's just that you say that it might not -- that it
 12 wasn't depleted uranium, it was something else?
 13 **A. The authors don't give that information so you cannot**
 14 **draw that conclusion.**
 15 Q. Well, I don't -- I'm not --
 16 **A. They don't state it, I don't state it.**
 17 MR JUSTICE BLAKE: I think you have the answer. She's not
 18 criticising the study or the conclusion. She simply
 19 says the conclusion is so generally expressed as not to
 20 be depleted uranium-specific which I understood to be
 21 the answer to the question.
 22 DR BUSBY: I understand, my Lord.
 23 MR JUSTICE BLAKE: It may well be relevant whether they were
 24 claiming pensions for service in the Gulf which is
 25 fortunately not what we are going to be doing.

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1 DR BUSBY: If I could just go to one point to just clear
 2 this up. You just told the Tribunal that the relative
 3 risks were very small.
 4 **A. I didn't talk about relative risks.**
 5 Q. Can we just go to the results where it says "results" in
 6 the abstract.
 7 MR JUSTICE BLAKE: Shall we go to the results in the actual
 8 --
 9 DR BUSBY: We can do that, but I hope that we can assume
 10 that the results in the abstract are not different from
 11 the results in the bulk of the paper.
 12 MR JUSTICE BLAKE: Do you want to go --
 13 **A. I'm not disputing their results.**
 14 **DR BUSBY: I thought you said they were rather small.**
 15 **A. They said that themselves, not me. I'm not disputing**
 16 **their results. I'm just telling you it's not**
 17 **necessarily depleted uranium because you can't deduce**
 18 **that from this paper.**
 19 **DR BUSBY: You agree the results were quite high?**
 20 **A. I wouldn't call them quite high if you look at the**
 21 **confidence intervals of some of them, certainly span 1,**
 22 **and that would make me question whether it's**
 23 **statistically viable. If you sample the population**
 24 **again or chose a different population, would you get the**
 25 **same result?**

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1 Q. But we're not looking at the confidence intervals.
 2 **A. I'm sorry, you should be looking at the confidence**
 3 **intervals because that tells you an awful lot about the**
 4 **study.**
 5 Q. If we look at the confidence intervals it says:
 6 "1.1 to 6.6. B equals 0.039."
 7 **A. It depends on which one you look at. There's a previous**
 8 **one there that says:**
 9 **"Confidence interval 0.97 to 1.89."**
 10 Q. Well --
 11 **A. You've picked the highest one, Dr Busby. With respect,**
 12 **there are others there.**
 13 Q. I am looking at the one in the "results" section at the
 14 top, the "results" section in the abstract. The first
 15 one that they write about heart defects, aortic
 16 stenosis.
 17 **A. Where are you?**
 18 Q. In the abstract where it says "results".
 19 MR JUSTICE BLAKE: Dr Busby is taking this point from the
 20 first page of the paper, the second bold type heading in
 21 the abstract "Results", "Infants conceived post-war ..."
 22 Am I in the right territory?
 23 MR HEPPINSTALL: The abstract was in a different format in
 24 the bundle.
 25 **A. Ah, okay.**

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1 MR JUSTICE BLAKE: If you go to the paper --
 2 **A. So this is still -- which paper is it now?**
 3 MR JUSTICE BLAKE: "Prevalence of birth defects."
 4 **A. Sorry, I was looking at the wrong paper in that case.**
 5 **That's why I couldn't find it.**
 6 **DR BUSBY: Areneta.**
 7 MR HEPPINSTALL: I think, Professor, you need to turn to
 8 SB7/93 in the bundle.
 9 **A. Yes, okay, got it.**
 10 MR HEPPINSTALL: You don't appear to have this. (Indicated)
 11 **A. Yes, I do, it's behind.**
 12 MR JUSTICE BLAKE: Is that the first page of the actual --
 13 **A. The abstract should be identical.**
 14 MR HEPPINSTALL: That's the abstract.
 15 MR JUSTICE BLAKE: I am not dealing with that abstract.
 16 I am dealing with the abstract in the article.
 17 MR HEPPINSTALL: But Dr Busby is --
 18 MR JUSTICE BLAKE: Well --
 19 **A. I think the wording is the same, my Lord.**
 20 MR JUSTICE BLAKE: Can we go back to the actual article
 21 because then we can stick --
 22 **A. I was looking at the wrong paper.**
 23 MR JUSTICE BLAKE: Fine. We've got the right paper?
 24 **A. Yes.**
 25 MR JUSTICE BLAKE: We have the "Prevalence of birth

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1 defects", and we see on that first page what I believe
 2 is the same abstract. I haven't checked it so I can't
 3 be sure. We have background and results and I think so
 4 far I'm helping you to where Dr Busby is on that --
 5 **A. Yes, I've got it now.**
 6 MR JUSTICE BLAKE: Just look at those results there and
 7 Dr Busby will ask you a question. Just give her
 8 a chance to read that section.
 9 **A. Yes.**
 10 MR JUSTICE BLAKE: I think the question was really: do you
 11 say that those are small or do you have any comment
 12 about the statistical base on which --
 13 **A. No, I mean when you see confidence intervals that span 1**
 14 **you do question whether it is a valid finding. Some of**
 15 **these do not span 1, so you would say that it may be**
 16 **a valid finding. There are huge confidence intervals on**
 17 **some of these as well which tell you it's an extremely**
 18 **variable result. So again there are certain things you**
 19 **look for in scientific papers that urge you to have**
 20 **caution interpreting it, whether is you can just spread**
 21 **it across the whole population, and the span of**
 22 **confidence intervals and the range of the confidence**
 23 **intervals tells you whether this is something that might**
 24 **be suspicious and might not be borne out if you did the**
 25 **study again. That's all I am saying.**

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1 **DR BUSBY: But is it not true, Professor Thomas, that the**
 2 **reason for -- that the size of the confidence, the span**
 3 **of the confidence interval, is the actual size of the**
 4 **sample, so if there's a very rare congenital**
 5 **malformation then obviously the confidence intervals**
 6 **will be --**
 7 **A. But if it's specific to the cause you are identifying**
 8 **you will expect those confidence intervals to be**
 9 **smaller, so if you have a variability like that it**
 10 **suggests there may be more than one thing that is**
 11 **leading to that result. And you have to take into**
 12 **account what the authors themselves say. They are aware**
 13 **that they have not controlled for inherited,**
 14 **environmental or synergistic factors. So this might be**
 15 **due to exposure to something in these veterans. It also**
 16 **might be likely to be due to other factors and in order**
 17 **to pin down which of the many factors that affect this**
 18 **phenotype, you would have to do more research and you'd**
 19 **have to control for those other factors. Then you could**
 20 **say with confidence what you would like to say, is that**
 21 **this is caused by depleted uranium.**
 22 Q. So it's your position that it may be some inherited
 23 congenital defect that is shared by the 30,000 or 15,000
 24 Gulf War veterans. So it's not because of the fact that
 25 they were in the Gulf War but they accidentally or by

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1 some unknown effect all shared some genetic defect which
 2 led to this --
 3 **A. I'm not alleging that all. Please don't put words in my**
 4 **mouth like that.**
 5 Q. Sorry, I thought that's what you said.
 6 **A. No, I'm not alleging that.**
 7 MR JUSTICE BLAKE: Ask the question.
 8 **A. There are many factors, one of which might be genetic**
 9 **factors, but I am not in any circumstances suggesting**
 10 **there might have been a genetic problem in certain Gulf**
 11 **veterans. I think that would be extremely wrong.**
 12 **DR BUSBY: Thank you. All right, I'm going to try and**
 13 **pursue this genetic mutation argument back to Chernobyl.**
 14 **So I want to look at SB6/89. Have we all got that?**
 15 **First of all I should say that this paper has**
 16 **been -- is one that has my name on it, although it was**
 17 **essentially a paper by Professor Schmitz Feuerhake and**
 18 **I think you were here when she was talking about this.**
 19 **A. I was here.**
 20 Q. Now what we have done, in case this not admissible
 21 my Lord --
 22 MR JUSTICE BLAKE: No, no, you can ask questions about it.
 23 DR BUSBY: Okay. So that saves us a lot of time because we
 24 printed it out.
 25 MR JUSTICE BLAKE: Yes.

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1 DR BUSBY: Have you seen this paper?
 2 **A. Yes, I have.**
 3 Q. It was put in. Okay.
 4 **A. No, I saw it before the trial.**
 5 Q. Now this paper refers to in table 1 -- if we can go to
 6 table 1. Got that?
 7 **A. Yes.**
 8 Q. It goes to a very large number of studies that show
 9 increases in congenital malformations after Chernobyl in
 10 various parts of Europe and Belarus and Ukraine,
 11 including some really quite closely studied and argued
 12 and measured relationships between radiation and this
 13 increase in congenital malformations.
 14 So my question is: do you agree that all of this
 15 evidence that is referred to in this paper shows that
 16 there was an increase in congenital malformation in
 17 Europe in people who were exposed to radiation from the
 18 Chernobyl accident?
 19 **A. I have had the chance to read some of the papers cited**
 20 **here, because this is a review, it's not got any new**
 21 **data in it, so it's just a review of the studies.**
 22 Q. Correct.
 23 **A. So whether it proves its point depends on the data from**
 24 **which it's actually drawn. So I haven't read all of**
 25 **them because I didn't receive the paper in time to do**

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1 **that. I have read some of them, and actually if you**
 2 **read a lot those papers -- I think we have them should**
 3 **we need them -- you'll find a lot of them say "We did**
 4 **not control for other factors such as folate",**
 5 **et cetera, which is known to affect particularly neural**
 6 **tube defects.**
 7 **So I would be very concerned as a scientist in**
 8 **taking this paper as meaning anything more than a review**
 9 **and you need to go to the original references to look to**
 10 **see if there are other confounders in those studies.**
 11 **Virtually all of the ones that I have read, some of them**
 12 **actually state it themselves, but they do not control**
 13 **for the other things that we know affect congenital**
 14 **health.**
 15 Q. But some of them did?
 16 **A. The ones I read there was not a single one where they**
 17 **controlled for it and I'm sorry, they were also fairly**
 18 **small which again, all of my reservations about small**
 19 **studies come into play.**
 20 Q. So your answer to that is no?
 21 **A. My answer is these are not good papers. So the answer**
 22 **is no, they have not proven it to be statistically**
 23 **significant.**
 24 Q. But all of the papers show that it is statistically
 25 significant but you --

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1 **A. Actually most of them don't have any proper stats on**
 2 **them, to be honest.**
 3 Q. But you are saying you think the studies are too small,
 4 like you said before. That's right, is it?
 5 **A. I'm sorry. As a scientist that is my position.**
 6 Q. Of course. That's the answer.
 7 MR JUSTICE BLAKE: I just want to understand your answer
 8 there. You are not taking issue with the paper, but you
 9 are saying the answer to the paper depends upon what is
 10 contained in the papers which have been reviewed?
 11 **A. Yes, the arguments set out in this paper depend on the**
 12 **validity of the studies that they are citing.**
 13 MR JUSTICE BLAKE: Are the studies those mentioned in table
 14 1?
 15 **A. Yes, I believe they are. I think they are mentioned in**
 16 **the references as well.**
 17 MR JUSTICE BLAKE: Right. Now just using that table if we
 18 can -- does it go on to page -- yes, it does. Table 1
 19 goes over two pages, does it? Two-and-a-half pages?
 20 **A. Yes, it does. It goes on to page 5 as well.**
 21 MR JUSTICE BLAKE: Which ones are you familiar with?
 22 **A. There was a whole bundle of papers that were handed out**
 23 **if I could have that back.**
 24 MR HEPPINSTALL: If you look at SB22, the new bundle, at
 25 tab 6 it has those papers from table 1 which Dr Busby

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1 produced.
 2 MR JUSTICE BLAKE: I think my tab is empty.
 3 MR HEPPINSTALL: If you look at the index you can see it.
 4 MR JUSTICE BLAKE: Yes, yes.
 5 **A. I would need to have the papers to be able to refer to**
 6 **them but unfortunately I haven't got a bundle SB22 here.**
 7 MR JUSTICE BLAKE: Can we provide a bundle for the witness?
 8 MR HEPPINSTALL: I think your 6 would still be empty.
 9 MR JUSTICE BLAKE: No, no, don't worry about me.
 10 MR HEPPINSTALL: No, no, but I think the actual clip of --
 11 MR JUSTICE BLAKE: Okay, all right.
 12 MR HEPPINSTALL: I'll see if I can do that.
 13 MR JUSTICE BLAKE: If this is important --
 14 MR HEPPINSTALL: I can re-examine.
 15 MR JUSTICE BLAKE: -- you can re-examine.
 16 MR HEPPINSTALL: Yes, I can re-examine.
 17 MR JUSTICE BLAKE: Well, I'm afraid I lost the answer. You
 18 are saying that the validity of the conclusion in the
 19 paper depends upon an analysis of the literature that is
 20 being reviewed?
 21 **A. Yes, because there's no new data in this paper.**
 22 MR JUSTICE BLAKE: No new data, and some of the papers you
 23 are familiar with, some you are not?
 24 **A. I've read very recently.**
 25 MR JUSTICE BLAKE: All right.

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1 You weren't familiar with any of the papers until
 2 you were asked to read them?
 3 **A. I knew of them but I hadn't read them, you know, with**
 4 **fine --**
 5 MR JUSTICE BLAKE: With giving expert evidence in mind.
 6 Right.
 7 How many papers are there in there?
 8 DR BUSBY: There are about eight, my Lord.
 9 MR JUSTICE BLAKE: Eight. Is there any point in finding out
 10 whether the witness has got any comments on any of those
 11 eight papers?
 12 MR HEPPINSTALL: I can re-examine on that basis.
 13 MR JUSTICE BLAKE: All right. I'll leave that to you.
 14 DR BUSBY: This paper, Professor Thomas, I think you said
 15 that you read it before so you have read it -- it's not
 16 been sprung on you, I mean -- it also goes to -- it
 17 reviews other studies besides the Chernobyl studies that
 18 you say may not be valid, which also suggest that the
 19 risk from low doses of radiation are not properly
 20 estimated by the current radiation risk model?
 21 **A. No, I didn't say that at all.**
 22 Q. No, I'm sorry, I am asking you if you agree that this
 23 paper contains other evidence apart from the Chernobyl
 24 evidence?
 25 **A. It contains other evidence but I haven't read all of**

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1 **those papers in detail to tell you whether I would agree**
 2 **with the evidence in those papers so I can't possibly**
 3 **comment on the validity of the finding of this paper**
 4 **without doing that.**
 5 Q. Of course. Why not?
 6 **A. Why not? Because it doesn't give you the detail of the**
 7 **studies.**
 8 Q. No, that's not my question. My question is why didn't
 9 you look at that? I mean it's quite an important paper,
 10 isn't it?
 11 **A. Because quite frankly I didn't have years of my life to**
 12 **spend doing this and I could have looked at all of these**
 13 **but I have a job to do as well. So I looked at the**
 14 **things I thought were important. I read this paper, and**
 15 **I did not have time to go through absolutely everything.**
 16 **We did not get this until a couple of weeks ago.**
 17 Q. I think we provided this paper more than a couple of
 18 weeks ago. However --
 19 **A. Perhaps -- perhaps Mr Heppinstall --**
 20 Q. -- if we go to the conclusion here, which is in the
 21 abstract and I can tell you that that is the right
 22 conclusion, we don't have to go through the paper to
 23 find it.
 24 **A. I'm sorry, I don't understand how you can define it as**
 25 **the right conclusion --**

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1 Q. No, I'm not saying --
 2 MR JUSTICE BLAKE: I think he means the abstract accurately
 3 reflects the text of the article. I don't think you
 4 were being asked to endorse the whole paper.
 5 DR BUSBY: Well, essentially what this paper does is it
 6 collects together -- you agree that it collects together
 7 a lot of information, much of which you haven't read
 8 or --
 9 **A. I think it collects together selective information. It**
 10 **does not contain all of the references of the studies**
 11 **that have been carried out on this. Again, I would**
 12 **refer you to the UNSCEAR 2008.**
 13 Q. But 2008 is a long time ago, Professor Thomas.
 14 **A. Yes, but I don't think you'll find there's been huge**
 15 **numbers -- these studies take time. If you're going to**
 16 **do them properly you can't quickly turn them round.**
 17 Q. I think if you look in this you'll find that there are
 18 quite a few studies that have been done since then, but
 19 we won't argue the toss.
 20 I just want to come to some conclusion about this
 21 and move on.
 22 So the conclusion at the front of this in the
 23 abstract:
 24 "We conclude that the current risk model for
 25 heritable effects of radiation is unsafe."

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1 Would you agree with that?
 2 **A. No.**
 3 Q. "The dose response relationship is non-linear with the
 4 greatest effects at the lowest doses."
 5 Would you agree with that?
 6 **A. No.**
 7 Q. "Using Chernobyl data we derive an excess relative risk
 8 for all malformations [this is important now] of 1.0 per
 9 10 millisieverts cumulative dose."
 10 **A. I don't agree with that. I would actually refer you to**
 11 **the Little paper which I think is far better than this**
 12 **paper for reviewing the real data about teratogenic**
 13 **effects.**
 14 Q. We'll go to that eventually but not with you, I think
 15 so. That's a doubling dose at 10 millisieverts, that's
 16 what that means.
 17 **A. If you say so.**
 18 Q. No, I'm just saying that's what this says.
 19 **A. That's what you state.**
 20 Q. And you say that's wrong?
 21 **A. I don't think there is the evidence on which that can be**
 22 **based, given what I have read of the papers that have**
 23 **been referred to in this particular article.**
 24 Q. And so then it just concludes:
 25 "The safety of the Japanese A bomb epidemiology is

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1 argued to be scientifically and philosophically
 2 questionable owing to errors in the choice of control
 3 groups, submission of internal exposure effects and
 4 assumptions about linear dose response."
 5 Do you agree with that?
 6 **A. Again as I said, if you are going to ask me technical**
 7 **details about the LSS methodology, I'm not the person to**
 8 **answer. I'm not an epidemiologist.**
 9 Q. Thank you. I think that's all I want to do with that
 10 particular paper.
 11 I am now going to move on this because this paper
 12 does include within it as part of its review evidence
 13 reference to the studies that have been done on the test
 14 veterans, one of which has been the subject of some
 15 discussion in this arena.
 16 So what I want to do now is take you to SB6/84.
 17 For your information, my Lord, I intend to finish
 18 this by twelve o'clock if that would be okay.
 19 MR JUSTICE BLAKE: That would be very helpful.
 20 DR BUSBY: Yes. Now have you got this paper?
 21 **A. Yes, I have.**
 22 Q. This is a paper written by myself and Mireille
 23 de Messieres, which is the second study of the British
 24 Nuclear Test Veterans Association. And it was a study
 25 which appeared to show an increase in congenital

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1 malformation of about tenfold. Do you accept that that
 2 was a correct finding or that that finding was
 3 meaningful?
 4 **A. Not based on the methodology that was used. You heard**
 5 **the criticism yesterday of the methodology that was used**
 6 **in this. It is not of the same order of the paper that**
 7 **you showed me earlier about the Gulf veterans that was**
 8 **carried out on 15,000 veterans. That was indeed the**
 9 **same methodology but they made efforts to look at the**
 10 **bias that might have occurred because of the methodology**
 11 **they chose to use. This paper does not do that. So**
 12 **I think you have to be very careful how you interpret it**
 13 **and again these are small numbers.**
 14 Q. Well, I think that if you look at the abstract at the
 15 bottom here, all of this is conceded. It says:
 16 "Whilst caution must be exercised due to structural
 17 problems inherent in this study we conclude that the
 18 veterans' offspring qualitatively exhibited a prevalence
 19 of congenital conditions significantly greater than that
 20 of controls and also that of the general population in
 21 England."
 22 This was a very large excess. This was a tenfold
 23 excess that was found.
 24 So would you say that that might suggest that there
 25 might be an effect there?

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1 **A. No, because the paper is so poor -- and I'm sorry it's**
 2 **one of your papers and you must regard this as**
 3 **a criticism of you -- the methodology is so poor I would**
 4 **not regard this as scientific evidence.**
 5 Q. But as Dr Howard said maybe it's better than nothing?
 6 **A. Well, I'm sorry, if we took all science on "maybe it's**
 7 **better than nothing" I think we'd have a real issue with**
 8 **that. You have to do it properly, otherwise you end up**
 9 **with misinformation and that helps nobody.**
 10 MR JUSTICE BLAKE: Given this outcome, are you able to
 11 assist us on criticisms of the methodology or would you
 12 prefer --
 13 **A. Yes, this was a survey, my Lord. Again it was a survey**
 14 **sent to -- I can't remember how many it was -- about**
 15 **2,000 or was it 1,000 personnel?**
 16 MR JUSTICE BLAKE: 1,000 questionnaires were posted.
 17 **A. Yes, a small response rate, which again should trigger**
 18 **alarm bells. They had 280 that were returned. The**
 19 **number of valid questionnaires returned was 280 out of**
 20 **a total of 1,000 I think that it was sent out to.**
 21 **Although admittedly some of those addresses may not have**
 22 **been correct at the time, but still small.**
 23 MR JUSTICE BLAKE: A small response rate. Just headlines.
 24 **A. The controls were self-selected, which is not**
 25 **a recognised epidemiological model.**

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<p>1 MR JUSTICE BLAKE: Yes?</p> <p>2 A. There was no validation of the reports that was given by</p> <p>3 the individuals responding to the survey.</p> <p>4 MR JUSTICE BLAKE: What, medical check-ups?</p> <p>5 A. Medical checks-ups, checking with the GP, et cetera.</p> <p>6 That could have been done. So you don't know whether</p> <p>7 this was a biased sample again because it's usually</p> <p>8 those who have an axe to grind that respond to surveys</p> <p>9 as all of us who lecture know. It's usually the</p> <p>10 students who didn't like your lecture who respond to the</p> <p>11 survey of "How was the lecture for you?" So there's</p> <p>12 an issue there.</p> <p>13 Quite frankly, without those validations I think you</p> <p>14 have to be very careful whether you take this as being</p> <p>15 representative.</p> <p>16 MR JUSTICE BLAKE: Right, thank you.</p> <p>17 A. But the other study was quite different in its approach.</p> <p>18 It was much, much larger, it had the appropriate control</p> <p>19 selection and they did make a great effort to determine</p> <p>20 whether the questionnaires that had come back could have</p> <p>21 some from a biased sample. So there is a distinct</p> <p>22 difference between the two studies.</p> <p>23 MR JUSTICE BLAKE: Right. It's suggested nevertheless that</p> <p>24 if people do report these health defects that's better</p> <p>25 than nothing.</p> <p style="text-align: center;">Page 77</p>	<p>1 Q. -- to obtain the original evidence -- the original</p> <p>2 questionnaires, all of the questionnaires and in fact</p> <p>3 they have been supplied also to the Secretary of State.</p> <p>4 Now, we reduced those questionnaires to numbers and</p> <p>5 went over them to see what the rates were relative to</p> <p>6 the expected numbers in the British population using the</p> <p>7 EUROCAT database. Have you read this report?</p> <p>8 A. I have read this report, yes.</p> <p>9 Q. Yes. So you will see that the findings of</p> <p>10 Professor Howard on the numbers that he saw gave a live</p> <p>11 birth prevalence rate for congenital anomalies of about</p> <p>12 10 per thousand births and he writes:</p> <p>13 "These results agreed quite well with the later 2006</p> <p>14 study ..."</p> <p>15 Which is the one that you just looked at.</p> <p>16 This was an earlier sample, a different sample and</p> <p>17 much larger sample.</p> <p>18 A. Sorry, can you -- which one are you reading?</p> <p>19 MR JUSTICE BLAKE: I think you've just been directed to the</p> <p>20 last page of the report at 2.9.</p> <p>21 A. Yes.</p> <p>22 MR JUSTICE BLAKE: The last paragraph says:</p> <p>23 "These results agreed quite well with the later 2006</p> <p>24 study by Busby and de Messieres, published in 2012."</p> <p>25 Which I gather is what we've just been looking at.</p> <p style="text-align: center;">Page 79</p>
<p>1 A. I disagree with that. I'm afraid I was schooled in</p> <p>2 scientific method by the Swiss and it is very much that</p> <p>3 you have to know that the method you are choosing is</p> <p>4 appropriate to answer the question that you are</p> <p>5 answering, and if it is not you don't answer the</p> <p>6 question, because you can end up with a badly designed</p> <p>7 result which can skew information given to others,</p> <p>8 particularly when you write reviews and things like</p> <p>9 that.</p> <p>10 MR JUSTICE BLAKE: Right. I think we have this witness'</p> <p>11 views on --</p> <p>12 DR BUSBY: We will continue with this issue of the</p> <p>13 congenital malformations in the veterans' offspring by</p> <p>14 going to Professor Howard's supplementary report at</p> <p>15 SB1/2.9.</p> <p>16 A. 2.9?</p> <p>17 Q. 2.9, expert witness statement.</p> <p>18 MR JUSTICE BLAKE: I think that's what we were told. Yes.</p> <p>19 Do you have that?</p> <p>20 A. Mm-hm.</p> <p>21 MR JUSTICE BLAKE: "Expert report, supplementary statement."</p> <p>22 DR BUSBY: You were I hope aware that the Tribunal made</p> <p>23 a third party disclosure order to the University of</p> <p>24 Dundee --</p> <p>25 A. Yes.</p> <p style="text-align: center;">Page 78</p>	<p>1 A. Yes, so these are separate questionnaires?</p> <p>2 MR JUSTICE BLAKE: Yes.</p> <p>3 A. Completely separate?</p> <p>4 MR JUSTICE BLAKE: Yes.</p> <p>5 DR BUSBY: Much earlier. It was 1998 that these</p> <p>6 questionnaires were sent out.</p> <p>7 MR JUSTICE BLAKE: This was a different sampling --</p> <p>8 A. I think we'd have to look at the Rabbitt Roff paper</p> <p>9 because I take it that the data from that, those survey</p> <p>10 questions went into the Rabbitt Roff paper. So again</p> <p>11 there's no detail here about number of questionnaires</p> <p>12 handed out and response rates and whether there was, you</p> <p>13 know, any notice taken of a possible bias. So again</p> <p>14 we'd have to look at the Rabbitt Roff paper to be able</p> <p>15 to discuss this properly I think.</p> <p>16 MR JUSTICE BLAKE: Yes.</p> <p>17 DR BUSBY: So --</p> <p>18 A. You can't just take numbers like that without proper</p> <p>19 reference to the methodology.</p> <p>20 MR HEPPINSTALL: My Lord will recall Dr Haylock provided</p> <p>21 a bespoke response to this.</p> <p>22 MR JUSTICE BLAKE: Quite. We are getting a lot of value out</p> <p>23 of this witness and the things that she can tell us</p> <p>24 about. But it may be best to take this point with</p> <p>25 Dr Haylock.</p> <p style="text-align: center;">Page 80</p>

1 DR BUSBY: I think so, my Lord, but I have asked her whether
 2 she agrees and she doesn't agree.
 3 **A. I can't agree because I haven't got the data in front of**
 4 **me to make up my mind.**
 5 MR JUSTICE BLAKE: Can I ask you this question. Let us
 6 suppose -- imaginary, and we'll find out whether the
 7 imagination and the real have a nodding acquaintance --
 8 you did get a survey of 100, 200, 300 veterans who
 9 report congenital defects in their offspring.
 10 **A. Yes.**
 11 MR JUSTICE BLAKE: And if what they were reporting were
 12 accurate, and if, that you have mentioned in your five
 13 critiques of the previous survey, you have apparent
 14 anomalies, can you not compare with the general
 15 expectation of birth rates in the British population?
 16 Is at least that comparison --
 17 **A. Well, it depends on what your question is, my Lord, at**
 18 **the end of the day. It is are they different from the**
 19 **general population? Or can I assign a causation to**
 20 **their birth defects?**
 21 MR JUSTICE BLAKE: Well, the first question. If you are
 22 asking for birth defects or specific birth defects --
 23 but it may be birth defects if the informants are not
 24 themselves pediatric pathologists or something (which
 25 they may not be) -- asking for birth defects --

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1 **A. Yes.**
 2 MR JUSTICE BLAKE: -- you then get some information.
 3 **A. Mm.**
 4 MR JUSTICE BLAKE: Is it not then -- is it good science or
 5 bad science? But I mean isn't it not some information
 6 if you compare that product, with the caveats as to the
 7 accuracy of the answer and who you have asked and how
 8 you have selected it, but for getting a controlled group
 9 now, because don't you then -- can't you use the general
 10 stats as a form of control?
 11 **A. You'd have to look at the composition of the two groups.**
 12 **So if you were able to statistically prove there was no**
 13 **difference in your population, which might be quite a**
 14 **selective population.**
 15 MR JUSTICE BLAKE: Well, it would be --
 16 **A. -- because they would be of a certain age and all the**
 17 **rest of it, and probably a certain social class with**
 18 **certain habits, et cetera. To be a fair comparison you**
 19 **would have to select the same group with the identical**
 20 **characteristics from the general statistics, otherwise**
 21 **you could be comparing apples and oranges.**
 22 **That will work both ways for you, you might have**
 23 **something that is very specific in your group, but you**
 24 **would lose it in the noise of the general sort of needle**
 25 **in a haystack of looking for it in the general**

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1 **population.**
 2 **So you have to compare two groups that are the same.**
 3 **So you would ask a statistician to look at the format of**
 4 **your group, age, sex, smoking history, all the rest of**
 5 **it, and then say, "I will extract a group that has the**
 6 **same characteristics in the general population." Then**
 7 **you would have a degree of security of knowing that you**
 8 **were comparing two groups of similar backgrounds.**
 9 **So you'd have to start there. You can't just**
 10 **generally compare it because you don't know it's**
 11 **an accurate comparison. You could be comparing two**
 12 **groups with very different phenotypes.**
 13 MR JUSTICE BLAKE: Right.
 14 DR BUSBY: I think what you've just said -- and correct me
 15 if I'm wrong -- the general population has a very
 16 different genotype --
 17 **A. No, I'm not saying that at all.**
 18 Q. I think you just said that.
 19 **A. No, I didn't. "Phenotype", not "genotype".**
 20 Q. Well, I don't understand how phenotype affects
 21 congenital malformations.
 22 **A. I think you are completely misunderstanding. When you**
 23 **do a statistical study, to reduce variance in the**
 24 **population what you needed to do is -- if you are**
 25 **looking for a causative effect -- is to compare two**

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1 **groups that, in every other respect, apart from your**
 2 **causative effect, are very similar. That's what I mean**
 3 **by having the same phenotype. Nothing to do with genes**
 4 **- phenotype.**
 5 **That means the comparators that you use. So age,**
 6 **sex, race. I mean that's a very common one that we have**
 7 **to control for because, you are right, in different**
 8 **races there are different genetics. So one of the**
 9 **things that you control for is all of those things. If**
 10 **you don't then you are not comparing two groups that are**
 11 **comparable before you start. So if you have**
 12 **a difference in one group you know then that it is due**
 13 **to the cause that you are investigating because you have**
 14 **controlled the other variables.**
 15 Q. So in the nuclear worker studies -- and there have been
 16 many of them -- that compare the nuclear workers' cancer
 17 rates or rates of congenital malformation with the
 18 general population and expectation, you would say that
 19 those studies were all invalid or questionable, would
 20 you?
 21 **A. Because they're very large studies those statistical**
 22 **inaccuracies do pale a little, but again it isn't me you**
 23 **should be asking, it's Dr Haylock.**
 24 MR JUSTICE BLAKE: I think we are getting the message that
 25 if you are really going to go on with these

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<p>1 epidemiological surveys you are going to have to ask an 2 epidemiologist. 3 DR BUSBY: Yes, that's right, my Lord, I will. 4 MR JUSTICE BLAKE: Bearing in mind it's now ten to twelve. 5 DR BUSBY: I will finish by twelve, I promise, even if 6 I have to just stop in mid-sentence. 7 MR JUSTICE BLAKE: No, no, I am not -- I am asking for an 8 estimate. 9 DR BUSBY: Or fall over maybe, another possibility, or crash 10 sideways. 11 These answers are rather doing my head in, I'm 12 afraid. 13 Okay. Now, can we go to SB7/123. You are familiar 14 with this paper? 15 A. Yes. 16 Q. I am sure you are because it's quite a cause celebre 17 amongst these cases. Would you agree that what it shows 18 is that there is an excess chromosome damage, chromosome 19 translocation frequencies, and also they studied 20 chromosome aberrations in some cases. 21 A. Again, I have questions over the methodology used. 22 Again, it was a small sample size. When we look for 23 chromosome abnormalities, when we study patient samples, 24 we don't just do one part of the cells, we will do 25 multiple sampling to look for regional variance and</p> <p style="text-align: center;">Page 85</p>	<p>1 Now we find that other people who are exposed to 2 radiation, anyway, and also certainly to uranium, 3 because that's what the bombs were made of, show 4 chromosome damage. 5 Do you not think, Professor Thomas, that there may 6 be some background element or cause or thing that might 7 be associated with all of these things that they have in 8 common, exposure to uranium? Do you think that might be 9 a possibility? 10 A. Firstly, I don't think anybody disputes that uranium is 11 chemically genotoxic; we have lots of evidence on that. 12 We do dispute that it causes cancer in man; we don't 13 have the evidence on that. These are small studies. 14 I'm afraid, I think most people believe that if 15 something is in the scientific literature it's a valid 16 paper. That is not the case, and as good scientists we 17 are trained to look at these papers and say, "Can those 18 conclusions be drawn by that paper?" If they can, you 19 will include it in your analysis; if they cannot, or 20 they are suspect, you will not include it. 21 That's a process of science that we're all taught 22 from degree level onwards. 23 Q. Well, let's go back to the process of science briefly. 24 Science is based on a number of philosophical arguments 25 about causation, one of the most important of which is</p> <p style="text-align: center;">Page 87</p>
<p>1 things like that and I can't see any statistics on that 2 in this. 3 So although they looked at a large number of cells, 4 they looked at a relatively small number of individuals. 5 Again, my queries are the same as they were for previous 6 studies, it's a very small sample size, you don't know 7 it's representative of the larger group. 8 So it says what it says, but whether you can draw 9 conclusions as to the larger group and to other groups 10 of veterans, I'm afraid I would not be happy with 11 drawing that conclusion from this. It's statistically 12 unsound. 13 Q. So let me put this to you. We have, this morning, 14 looked at papers by Professor Miller in America who 15 works for the military who shows that uranium, maybe 16 chemically, maybe not, but you think chemically, causes 17 chromosome effects or DNA damage in cell cultures. Then 18 we have looked at papers that have shown that the 19 uranium miners have high levels of chromosome damage, 20 statistically significant, but you say a very small 21 sample. We have then looked at Gulf War veterans who 22 have had chromosome analysis carried out, and they have 23 been exposed to uranium, amongst other things, you say. 24 And they have also shown high levels of chromosome 25 damage.</p> <p style="text-align: center;">Page 86</p>	<p>1 the canon of agreement which was propounded by John 2 Stuart Mill and the system of logic in I think 1888, but 3 I may be wrong about that, but thereabouts. He would 4 say -- or what it says is that if you see -- if there is 5 a difference between the antecedent of events for an 6 occurrence which you are interested in, if there is 7 an agreement between those, then it could be, or this is 8 evidence, that it is these antecedent events that are 9 the cause of what it is you are looking at or related to 10 that cause. 11 Would you agree with John Stuart Mill? 12 A. I would add caveats on that for biological systems. If 13 there are repeated, small samples of a single population 14 that has defined exposure, defined phenotypic 15 characteristics about it and they all point the same 16 way, then that might be evidence. If you take 17 individual studies from different populations done with 18 different methodology, all incredibly small, effectively 19 you are compounding the error. 20 So no, I do not agree with that, unless you modify 21 what you are saying. 22 Q. So you are saying if you find the same thing a lot of 23 things places -- 24 A. From totally different studies which are all flawed with 25 the same problem, you could actually be building</p> <p style="text-align: center;">Page 88</p>

1 **something on a false foundation.**
 2 Q. But they all same the same thing.
 3 **A. Don't care. The answer to that is individually they do**
 4 **not stack up. If you find large studies done in**
 5 **different populations with good scientific method**
 6 **showing all the same things then I would agree with you,**
 7 **but these studies do not support that argument, they are**
 8 **small studies, inherent with statistical error, which do**
 9 **not come from the same population, they have not been**
 10 **subsequently repeated by somebody else on that**
 11 **population. That is one thing that we insist on in**
 12 **medicine, is that things are repeated by somebody else**
 13 **then you know the result is really valid.**
 14 Q. Well, in that case I want to take you to SB7/114.
 15 MR JUSTICE BLAKE: So you are leaving this paper behind now,
 16 are you?
 17 DR BUSBY: I don't see that I can go any further with this
 18 witness on that paper. Is that the right one? No,
 19 sorry, we want the New Zealand one.
 20 **A. Is it the one you handed out last night?**
 21 **DR BUSBY: Yes. This is a Rabbitt Roff study, but it's the**
 22 **subset of Rabbitt Roff.**
 23 MR HEPPINSTALL: We have it at SB/22.10.
 24 DR RAYNER: It has been put in in the second half of 115,
 25 I believe.

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1 DR BUSBY: Yes. New Zealand Naval Frigates. Two Royal New
 2 Zealand Naval --
 3 MR JUSTICE BLAKE: I am not sure that there is consensus as
 4 to where we are going to put it. SB7 or in SB22?
 5 DR BUSBY: Well, we have it at SB -- all right.
 6 MR JUSTICE BLAKE: Where have you put it?
 7 MS BUSBY: It is continuous with the previous pages in 115,
 8 my Lord.
 9 DR BUSBY: Yes. At the back of 115.
 10 MR JUSTICE BLAKE: Could we put it at the back of 115.
 11 DR BUSBY: Yes, that would be reasonable.
 12 So we will recall that we were looking at a study by
 13 Rowlands' team, Wahab and Rowlands, that showed a very
 14 high level of congenital -- no, what -- of chromosome
 15 aberration translocations in a sample of New Zealand
 16 test veterans who had been on ships that had been
 17 whizzing up and down at the time of the Grapple -- the
 18 various Grapple tests, over about a year. So they went
 19 to various -- they were in various Grapple tests?
 20 **A. Can I just correct you there. They weren't uniformly**
 21 **high, they were distributed. Some had high, some did**
 22 **not have any.**
 23 Q. Yes, we are going to come to that one as well.
 24 But let's just start with the fact that some of them
 25 were high, on average there were a lot of high levels of

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1 dose, or what they called dose.
 2 So I just want to take you to page 30 --
 3 **A. Yes.**
 4 Q. -- of this submission, this Rabbitt Roff paper, which
 5 was published in the peer review literature. I want to
 6 look at conceptions here.
 7 **A. Mm-hm.**
 8 Q. So there were 443 conceptions reported for the 235 men,
 9 and of these 22 per cent were miscarriages, 16 per cent
 10 were still born and 2 fetuses were aborted. Do you
 11 think that would be normal in a population of that size?
 12 **A. I don't know. Reproductive numbers are not in the**
 13 **forefront of my brain, I am afraid I am too old for**
 14 **that.**
 15 Q. It seems rather high, don't you think?
 16 **A. Unless we have a control data from New Zealand, I think**
 17 **it would be difficult to know whether those were low or**
 18 **high. Again, I hate to say this and I hate to keep**
 19 **repeating myself, this is a self-reported questionnaire**
 20 **with only about 45 per cent response rate. You don't**
 21 **know this was unbiased, and they have made absolutely no**
 22 **attempt to address any bias that might be there or even**
 23 **noted there will be a bias there.**
 24 Q. Let's canter on. The second sentence:
 25 "Of these 117 prenatal and still born deaths a large

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1 number were reported as severely deformed."
 2 What would you comment on that?
 3 **A. I can't comment on it because I don't have the data to**
 4 **be able to compare it with to tell you whether that is**
 5 **unusual.**
 6 Q. So you think maybe that would be usual at 26.4 result of
 7 conceptions did not result in --
 8 **A. Again, they are self-reported --**
 9 MR JUSTICE BLAKE: Okay, I think you've made the point.
 10 She's not going to comment upon the conclusions because
 11 she doesn't have enough information --
 12 **A. And the methodology is flawed, my Lord.**
 13 **DR BUSBY: I think what I am asking you to say is whether**
 14 **you think that the background data from New Zealand, if**
 15 **you like the control group, would have such high levels**
 16 **of --**
 17 **A. The answer is I don't know, I don't have those**
 18 **statistics and I am not going to hypothesise without the**
 19 **proper evidence. That would be wrong of me.**
 20 Q. Just as an ordinary person.
 21 **A. I'm not prepared to speculate. I'm not here to**
 22 **speculate.**
 23 MR JUSTICE BLAKE: You have her answer.
 24 DR BUSBY: I think that's as far as I can go with that,
 25 my Lord.

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1 Well, by my watch it's 11.59 and 45 seconds and so,
 2 actually, I have finished my cross-examination, my Lord.
 3 MR JUSTICE BLAKE: All right.
 4 DR BUSBY: You will be glad to hear.
 5 MR JUSTICE BLAKE: Thank you very much. Thank you
 6 Professor Thomas.
 7 **A. Thank you.**
 8 **Questions from the Tribunal**
 9 MR JUSTICE BLAKE: Mr Heppinstall, just before you
 10 re-examine, Dr Rayner would like to ask a question. It
 11 may be helpful for you to have the answer before you
 12 re-examine.
 13 DR RAYNER: Can we go back to SB7, I'm afraid.
 14 **A. Yes, I have it in front of me.**
 15 DR RAYNER: 123. So I think you were in court yesterday
 16 when these studies were discussed?
 17 **A. Hang on a second. I'll get there now. 123, yes?**
 18 DR RAYNER: Yes. I am not going to ask you about the
 19 studies first of all, I just want to ask your general
 20 opinion on the validity of the mFISH technique and its
 21 application.
 22 **A. Yes, not good, I think. I mean, there's been a lot of**
 23 **discussion about looking at chromosomal aberrations**
 24 **using these type of techniques. I don't think we would**
 25 **use these any morning going into the future, we turn to**

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1 genome sequencing and things like that, because we can
 2 do it.
 3 These tests are -- I mean, usually you have to have
 4 quite a high impact on your cells. I think some of
 5 these were done a very long while after the actual
 6 exposure. I am interested -- I mean, that suggests to
 7 me that, if these are genuine, then those must be in
 8 stem cells because you will have lost your circulating
 9 lymphocytes during the 50-year period several times
 10 over. I find it very strange that these results are
 11 valid given the -- and due to radiation exposure, they
 12 could be due to many other things -- and due to
 13 radiation exposure after a 50-year gap.
 14 MR JUSTICE BLAKE: I know that my colleague was asking the
 15 question, and I am not presuming to take over her
 16 question, but I just wanted to break down your answer.
 17 **A. Sure, yes.**
 18 MR JUSTICE BLAKE: MFISH. You first started to say not
 19 a good technology for assessing.
 20 **A. Yes. It's not sensitive.**
 21 MR JUSTICE BLAKE: Enough. Or sensitive.
 22 **A. Yes.**
 23 MR JUSTICE BLAKE: And you prefer to do what?
 24 **A. We'd now do whole genome sequencing. Because of the**
 25 **human genome having been sequenced we can do that fairly**

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1 **cheaply. Well, a thousand dollars.**
 2 MR JUSTICE BLAKE: Okay. I want to come on to the second
 3 point you've made, but I want to see whether it's
 4 an aspect of the first or a freestanding point.
 5 The gap between the event --
 6 **A. Yes.**
 7 MR JUSTICE BLAKE: -- whose causal significance is being
 8 debated, and the use of the mFISH --
 9 **A. Yes.**
 10 MR JUSTICE BLAKE: -- I'll stand corrected but I think it
 11 was about 45 years later?
 12 **A. Yes, it's a very long time period. Your blood cells**
 13 **turn over fairly rapidly, my Lord.**
 14 MR JUSTICE BLAKE: Now, does the use of the mFISH, despite
 15 the fact that you can now go to human genome sequencing,
 16 but assuming -- does that diminish as mFISH after
 17 45 years, or it's just the fact it's 45 years?
 18 **A. It's just it's 45 years --**
 19 MR JUSTICE BLAKE: So it's not a defect of the mFISH --
 20 **A. Yes. It may be, of course, by something else in those**
 21 **45 years that you haven't taken account of, because you**
 22 **would lose an awful lot of these abnormalities as your**
 23 **cells die and your lymphocytes do die over time.**
 24 MR JUSTICE BLAKE: So the passage of time rather than the
 25 use of mFISH diminishes the security of the conclusions

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1 you can make from the report?
 2 **A. Yes. It's fallen out of use because everybody knows**
 3 **it's a difficult technology that actually isn't very**
 4 **sensitive so a lot of people are not using it.**
 5 MR JUSTICE BLAKE: That's a freestanding point from
 6 40 years, is it?
 7 **A. Yes.**
 8 MR JUSTICE BLAKE: You have two points, I've called them 1
 9 and 2 in my notes, and I'm not sure that you have any
 10 more coming but those are the two points you've made.
 11 **A. Yes. I mean, normally this sort of test is used fairly**
 12 **soon after exposure to a substance.**
 13 MR JUSTICE BLAKE: Yes, I get that, but that is simply
 14 because the longer you wait the more problematic the
 15 results are going to be, is it?
 16 **A. Yes.**
 17 MR JUSTICE BLAKE: If we break down your second point,
 18 45 years, I have (a) -- now going to letters rather than
 19 numbers -- that some of the hypothetically-damaged cells
 20 will have died off?
 21 **A. Yes.**
 22 MR JUSTICE BLAKE: (b) other events might have happened in
 23 the data subject's life?
 24 **A. Yes. One of those would be obviously whether they've**
 25 **been exposed to other radiation sources as part of their**

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<p>1 diagnostic radiology or chemotherapeutic agents, et 2 cetera. 3 MR JUSTICE BLAKE: Well, maybe they've taken miners in 4 Chernobyl with uranium -- 5 A. Yes. 6 MR JUSTICE BLAKE: -- or something. 7 Anything else you want to comment upon? 8 A. No, I think that really addresses the questions. 9 DR RAYNER: So, moving on from that, in the report that 10 follows the published paper, so if you turn to page 40 11 of the report, still in the same tab. 12 A. Yes. 13 DR RAYNER: Do you have that? 14 A. Yes, I've got it. 15 DR RAYNER: Okay. So in the second paragraph down it talks 16 about the results found in French Polynesians with 17 thyroid cancer, which hopefully is definitely your -- 18 A. Yes, I don't actually know that paper. 19 DR RAYNER: Well, that was my next question: do you know 20 that paper? 21 A. No, I don't know that paper, I'd have to look it up. 22 DR RAYNER: Right. Okay. 23 Because this basically talks about the high level of 24 dicentric chromosomes, which then the conclusion of that 25 is that this is specific to radiation. What do you have</p> <p style="text-align: center;">Page 97</p>	<p>1 Q. Then there's another one over the page from Yoshisada 2 Shibata? 3 A. Yes. 4 Q. Then another one from Richard Wakeford and a number of 5 other authors; is that right? 6 A. Yes, that's right. 7 Q. What is the content of the letters? 8 A. That they make the point that the Tsuda paper was not 9 a well-performed study and that his conclusions were 10 invalid, in a nutshell. 11 Q. I think there is then a number of tabs, 30, 31, 32, 34 12 and 35. Ignore 34. It's 29, 30, 31, 32 and then 13 there's another letter at 35. 14 A. Yes. 15 Q. Are they all similar letters? 16 A. They are all similar because it caused quite an outcry 17 when it was published, and a lot of questions about why 18 it was published in the journal and who reviewed it. 19 Q. Is that what you were referring to earlier? 20 A. Yes. 21 Q. Tab 12, please. Page 7 of 51. We've looked at this 22 earlier in the proceedings. This is from the US Agency 23 for Toxic Substances and Disease Registry, "Case Studies 24 in Environmental Medicine". This is a paper on uranium 25 toxicity.</p> <p style="text-align: center;">Page 99</p>
<p>1 to say about that? 2 A. That has always been the perceived wisdom that 3 dicentrics -- which actually interestingly weren't 4 elevated in the paper itself -- is a response to 5 radiation, yes. And translocations do occur, but they 6 occur at a lower frequency. 7 DR RAYNER: Right. Thank you. I don't have any more 8 questions thank you. 9 MR JUSTICE BLAKE: Thank you. 10 Re-examination by MR HEPPINSTALL 11 MR HEPPINSTALL: Would you turn to SB4, and we are going to 12 start at 29. 13 A. 29? 14 Q. 29, yes. 15 A. Okay, got it. 16 Q. Can you tell the Tribunal what we are looking at, 17 please? 18 A. We are looking at a letter that was written in response 19 to the paper by Dr Tsuda that was published in 20 epidemiology earlier on this year. 21 Q. Is that the paper that we looked at earlier with 22 Dr Busby? 23 A. Yes. 24 Q. And this is a letter from Sadao Suzuki? 25 A. Yes, yes, there's two letters -- yes, that one.</p> <p style="text-align: center;">Page 98</p>	<p>1 At page 51 can you see where it says "three types of 2 natural uranium"? 7 of 51 is on the bottom-right 3 hand -- 4 A. Yes. 5 Q. -- and under "Definitions" we have "Where found", 6 "Milling and Radioactive Wastes" and "Three Types of 7 Natural Uranium". Do you see that? 8 A. Yes. 9 Q. It says: 10 "Natural uranium is a mixture of three types ... 11 U234, U235 and U238..." 12 Do you agree with that? 13 A. Yes. 14 Q. "All three isotopes behave [in the same way] chemically, 15 so any combination of the three would have the same 16 chemical effect on a person's health." 17 Do you agree with that? 18 A. Yes. 19 Q. "But they are different radioactive materials with 20 different radioactive properties." 21 Do you agree with that? 22 A. Yes. So I made a mistake earlier. 23 Q. What mistake did you take earlier? 24 A. I made a mistake and said that one of them was stable, 25 I misremembered that and that is a very silly mistake to</p> <p style="text-align: center;">Page 100</p>

<p>1 have made. But they are radioactive, but with 2 different -- 3 MR JUSTICE BLAKE: Radioactive properties. 4 A. Yes, exactly. 5 MR HEPPINSTALL: As you go down that page it says: 6 "Radioactive elements are those that undergo 7 spontaneous transformation in which energy is released 8 ... either in the form of particles, such as alpha or 9 beta ... or electromagnetic radiation with energies 10 sufficient to cause ionization, such as gamma or 11 X-rays." 12 Do you agree with that? 13 A. Yes. 14 Q. "This transformation or decay results in the formation 15 of different elements, some of which may themselves be 16 radioactive, in which case they will also decay." 17 Do you agree with that? 18 A. Yes. 19 Q. In the next paragraph: 20 "When an atom of any of these uranium isotopes 21 decays, it emits an alpha particle ... and transforms 22 into a radioactive isotope or another element." 23 Do you agree with that? 24 A. Yes. 25 Q. "The process continues through a series of radionuclides</p> <p style="text-align: center;">Page 101</p>	<p>1 Q. So my Lord will remember that it is my promise to go 2 back to the -- 3 MR JUSTICE BLAKE: Yes. 4 MR HEPPINSTALL: These are the papers from table 1, which we 5 have; is that right? 6 A. Correct. 7 MR HEPPINSTALL: Now, I hopefully have them in the same 8 order as you. 9 A. Starting with the Turkish paper. 10 MR HEPPINSTALL: The Turkish paper, which is Akar; is that 11 right? 12 A. Yes. 13 Q. Do you want to make any comments about this paper? 14 A. Again, they did not control or actually make any 15 statement about alcohol consumption -- which may be not 16 a problem in Turkey given its religious status, but 17 which we know affects neural tube defects -- but they 18 didn't take any account of folate deficiency that might 19 occur in that particular population. So without that 20 detail you cannot -- you are just associating, you are 21 not defining cause. 22 Q. Is there any evidence about dose in that -- 23 A. Absolutely none. 24 Q. If we turn over we get to, stretching my Ukrainian or 25 Russian pronunciation --</p> <p style="text-align: center;">Page 103</p>
<p>1 until it reaches a stable, non-radioactive isotope of 2 lead." 3 Yes? 4 A. That's correct. 5 Q. The next paragraph: 6 "In addition, each isotope has a different 7 radiological half-life or the amount of time it takes 8 for one-half of the atoms of the radionuclide to 9 transform." 10 Do you agree with that? 11 A. Yes. 12 Q. "U234 has the shortest half life and is, therefore, the 13 most radioactive, followed by [I think they mean in 14 order] U-235 and U238." 15 Do you agree with that? 16 A. Yes. 17 MR JUSTICE BLAKE: I thought for a dreadful moment they were 18 footnotes 235 and 238, but I was pleased to realise they 19 were in fact references to the items. 20 A. Yes. 21 MR HEPPINSTALL: Now, in SB22/6 -- 22 A. Yes. 23 Q. -- are these the papers you were referring to in table 1 24 of the Busby, Feuerhake, Flugbail paper? 25 A. Yes.</p> <p style="text-align: center;">Page 102</p>	<p>1 A. "Feshchenko". 2 Q. Thank you: 3 "Congenital malformations among newborns and 4 developmental abnormalities among human embryos in 5 Belarus after Chernobyl accident". 6 Do you have any comment to make about this paper? 7 A. Again, the the criticisms. But they also -- here they 8 have used the dose -- they have a supposed dose rather 9 than measured a dose or reconstructed a dose so you 10 would know what the individual dose was of the 11 participants. They've just simply related it to the 12 ground level dose, which is not really sufficient if you 13 want to pin down a causation to radiation because the 14 way you live, whether you stay indoors, whether you are 15 outdoors, and the food you eat, will contribute to your 16 dose. 17 So with no reconstruction of dose in this, again you 18 cannot really do more than just say, "Oh look, 19 interesting", you can't prove anything. 20 Q. Next in my -- 21 A. Again no folate and all the rest of it. 22 Q. Next in my compilation is a paper by Wolfgang Hoffmann? 23 A. Yes. 24 Q. "Fallout from the Chernobyl Nuclear Disaster and 25 Congenital Malformations in Europe".</p> <p style="text-align: center;">Page 104</p>

<p>1 Can you turn please to page 482.</p> <p>2 A. 482. Yes.</p> <p>3 Q. There you will find the conclusions. Could you read out</p> <p>4 the conclusion to the Tribunal -- the first sentence of</p> <p>5 the conclusion, please?</p> <p>6 A. Yes:</p> <p>7 "Whether radioactive fallout from the Chernobyl</p> <p>8 disaster has cause health effects in Europe cannot be</p> <p>9 answered with confidence at this point in time.</p> <p>10 Positive findings of congenital malformations and</p> <p>11 chromosome aberrations deserve thorough scientific</p> <p>12 investigation. Health effects cannot be readily</p> <p>13 dismissed on grounds of established risk co-efficients.</p> <p>14 Instead, their confirmation would question the</p> <p>15 prevailing paradigm of a linear dose response curve for</p> <p>16 small doses of ionising radiation."</p> <p>17 So basically he is saying, "There is evidence, but</p> <p>18 I can't work out what it means at the moment." This is</p> <p>19 the review paper again, rather than having substantial</p> <p>20 information of first hand data.</p> <p>21 Q. The next paper is I think by Kulakov and others, "Female</p> <p>22 reproductive function in areas affected by radiation</p> <p>23 after the Chernobyl power station accident".</p> <p>24 If you again go to the conclusion, please, and look</p> <p>25 at the third paragraph of the conclusion. Do you have</p> <p style="text-align: center;">Page 105</p>	<p>1 affects the dose actually received by people.</p> <p>2 Q. Then the next is Petrova, "Morbidity in a large cohort</p> <p>3 study of children born to mothers exposed to radiation</p> <p>4 from Chernobyl. If you turn to page 149 you will see</p> <p>5 the discussion. If you have a look at the second</p> <p>6 paragraph and provide your comment on that.</p> <p>7 A. 149. Sorry, where did you say?</p> <p>8 Q. 149, discussion section.</p> <p>9 A. Sorry, let me just read this for a second, because</p> <p>10 there's an important thing in the abstract as well.</p> <p>11 Q. Yes.</p> <p>12 A. The second paragraph simply says:</p> <p>13 "Nevertheless, caution must be emphasised when</p> <p>14 interpreting these results."</p> <p>15 So they are being quite honest.</p> <p>16 "Other environmental factors, such as exposure to</p> <p>17 pesticides among mothers in the cohort study may have</p> <p>18 confounded interpretation in the data. Other</p> <p>19 confounders such as viral infections, industrial</p> <p>20 exposure, cigarette smoking and inherent genetic</p> <p>21 susceptibility may also be causally related to disease</p> <p>22 or abnormalities in laboratory tests."</p> <p>23 They actually indicate in the abstract that they</p> <p>24 found decreased levels of copper and zinc from heavily</p> <p>25 contaminated Oblast findings that may be related more to</p> <p style="text-align: center;">Page 107</p>
<p>1 any comment to make about that?</p> <p>2 A. Starting, "It is difficult to interpret"?</p> <p>3 Q. Yes.</p> <p>4 A. Yes. Again, they are being honest and they are saying,</p> <p>5 "We can't really interpret this data and there's no</p> <p>6 definite information concerning the effects of minor</p> <p>7 dose of radiation on humans." So they are being quite</p> <p>8 honest that they can't actually interpret the data that</p> <p>9 they've got and say it is due to radiation.</p> <p>10 MR JUSTICE BLAKE: One of us -- Dr Rayner has these papers,</p> <p>11 so that's good. I am not interrupting --</p> <p>12 MR HEPPINSTALL: I am deliberately reading onto the</p> <p>13 transcript so that you can see --</p> <p>14 MR JUSTICE BLAKE: As it happens, we don't.</p> <p>15 MR HEPPINSTALL: Very well.</p> <p>16 Then the next one is a paper by Lazjuk, Belarus</p> <p>17 Institute for Hereditary Diseases, Minsk, "Changes in</p> <p>18 registered congenital anomalies in the Republic of</p> <p>19 Belarus after the Chernobyl accident".</p> <p>20 Do you have any comment to make about this paper?</p> <p>21 A. Again, it's similar comments to the ones before. They</p> <p>22 have the same flaws. Again, they're using ground</p> <p>23 measurements of radioactivity to infer actual dose to</p> <p>24 human beings without taking the trouble to reconstruct</p> <p>25 the dose and understand the different habitus that</p> <p style="text-align: center;">Page 106</p>	<p>1 inadequate nutrition, which we know affects perinatal</p> <p>2 health, than to radiation exposure. And they state that</p> <p>3 in the abstract. So the authors are being honest about</p> <p>4 their results.</p> <p>5 Q. We are almost there, the last one is Werteckecki,</p> <p>6 "Blastopathies and microcephaly in a Chernobyl impacted</p> <p>7 region of Ukraine". Do you have any comments to make</p> <p>8 about this paper?</p> <p>9 A. Again, the same problems arise in that they do not have</p> <p>10 information on folates deficiency, and in fact I think</p> <p>11 there was another paper by Dr Holt in The Lancet who</p> <p>12 looked at this paper, he is an expert in his field, and</p> <p>13 said you cannot draw conclusions that this was due to</p> <p>14 radiation as there are so many other confounders that</p> <p>15 would be present in that population. The largest of</p> <p>16 those being the folate.</p> <p>17 Q. Can you turn back now, please, to SB6/89.</p> <p>18 MR JUSTICE BLAKE: Are we leaving the topic?</p> <p>19 MR HEPPINSTALL: You can leave SB22 behind now, we are on</p> <p>20 the same topic.</p> <p>21 MR JUSTICE BLAKE: The same topic. Right. I might have</p> <p>22 a supplementary about Professor Hoffmann, but without</p> <p>23 having read it --</p> <p>24 MR HEPPINSTALL: If you wish to deal with it now, my Lord.</p> <p>25 MR JUSTICE BLAKE: Okay. Just in case -- so you don't have</p> <p style="text-align: center;">Page 108</p>

1 to take it out again -- as you may have heard -- well,
 2 two of us don't actually have these papers -- but I've
 3 just been looking at the passage that was put to you
 4 about the Hoffmann conclusions at 482. Do you want to
 5 just pick that out again. It's tab 6, it's the third of
 6 the three pages.
 7 **A. Yes, let me find the right paper.**
 8 MR JUSTICE BLAKE: Hoffmann, Fallout. The third page.
 9 **A. Got it.**
 10 MR JUSTICE BLAKE: Yes. So, now you're in the paper, go to
 11 482.
 12 **A. Yes.**
 13 MR JUSTICE BLAKE: You've been taken to the conclusions just
 14 before you get the references.
 15 **A. Yes.**
 16 MR JUSTICE BLAKE: Right. The first sentence shows what it
 17 shows. I don't need to ask you about that.
 18 **A. Mm-hm.**
 19 MR JUSTICE BLAKE: Cannot be stated with confidence.
 20 The second records positive findings.
 21 **A. Mm-hm.**
 22 MR JUSTICE BLAKE: Deserving thorough scientific
 23 investigation. You don't have any problems with that,
 24 I take it?
 25 **A. If they are indeed positive. I mean, that is the issue.**

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1 **He cites them as positive because it is in his**
 2 **interest -- use of English is always very interesting in**
 3 **these papers, most people are looking for more money to**
 4 **carry on their studies when they write this, so you have**
 5 **to bear that in mind -- but if these were positive, and**
 6 **I totally agree with him, if these were positive, from**
 7 **good studies, then they should be investigated properly**
 8 **and then we would have a scientific basis on which to**
 9 **know whether it is true or not.**
 10 MR JUSTICE BLAKE: "Health effects cannot be readily
 11 dismissed on grounds of established risk co-efficients."
 12 **A. I think you'll find that this gentleman has a particular**
 13 **view on risk co-efficients.**
 14 MR JUSTICE BLAKE: What your view?
 15 **A. I think we have to go on scientific evidence, and our**
 16 **risk co-efficients are based on good scientific papers,**
 17 **not rubbish. So I think, if you are using a risk**
 18 **coefficient that is scientifically rigorous, it's been**
 19 **examined, it's been actually supported in a number of**
 20 **recent studies --**
 21 MR JUSTICE BLAKE: I appreciate that, but supposing you
 22 can -- you can have the seed germ of an idea which might
 23 result in a where do you start is going to be the
 24 argument.
 25 **A. Yes, but you'd have to look at it with the same**

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1 **scientific rigour at any other model that you were going**
 2 **to put forward.**
 3 MR JUSTICE BLAKE: All right. Then it's the last one:
 4 "Instead, their confirmation would question the
 5 prevailing paradigm of linear dose-response curve for
 6 small doses of ionizing radiation..."
 7 Now, I have all the stuff you've given us, but if
 8 these results have been confirmed would they have that
 9 effect?
 10 **A. If they were confirmed, if, and there's -- "if" is the**
 11 **big --**
 12 MR JUSTICE BLAKE: I am not trying to slip you into
 13 agreeing with a proposition, but I just want to see
 14 whether the internal logic follows.
 15 **A. The internal logic is absolutely fine, but it's the**
 16 **basis on which you are determining your next step that**
 17 **I am questioning.**
 18 MR JUSTICE BLAKE: Although you've been through a lot of
 19 papers, do we know whether there has been any
 20 confirmation?
 21 **A. No. Actually, my Lord, there has not.**
 22 MR JUSTICE BLAKE: Has there been any study --
 23 **A. There have been studies -- again, I would refer you to**
 24 **the UNSCEAR annex, which will have chapter and verse on**
 25 **that.**

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1 MR JUSTICE BLAKE: This is 2000 --
 2 **A. Yes, and particularly Mark Little's paper as well,**
 3 **the other one that we were given recently, that reviews**
 4 **all of the literature in a very unbiased fashion.**
 5 MR JUSTICE BLAKE: So, even if internal logic saying
 6 something has emerged, it needs further studies, if the
 7 result of the study is to confirm the finding, it might
 8 have this effect, but that's okay. There's a bit of
 9 reasoning --
 10 **A. That's okay with the reasoning, but you would have to go**
 11 **and get a grant from a body who would have to look at**
 12 **the science and say is it reasonable.**
 13 MR JUSTICE BLAKE: Just to understand how much we -- what
 14 your more detail --
 15 **A. I don't have any problem with what he states there, it's**
 16 **whether they are genuine.**
 17 MR JUSTICE BLAKE: Got it. Sorry to interrupt you. Carry
 18 on.
 19 MR HEPPINSTALL: Not at all, my Lord.
 20 SB6/89, this is back to the paper from which the
 21 references we were just looking at are taken. SB6/89.
 22 Yes. Which is the Schmitz-Feuerhake, Busby, Pflugbeil.
 23 **A. Yes.**
 24 **Q. In the conclusion section of the abstract you were taken**
 25 **to a sentence:**

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<p>1 "Using Chernobyl data we derive an excess relative 2 risk for all malformations of 1.0 per 10 millisieverts 3 cumulative dose." 4 Do agree that's what that says? 5 A. I agree that's what that says. 6 Q. Can you turn to table 1, please. Now, you've not looked 7 at all of these references, but, you know, we've looked 8 at Hoffmann, Lazjuk Kulakov, Akar, Wertekceki, Petrova, 9 et cetera. 10 Now, you see here that in this table there's 11 a column which is marked "Estimated doses"? 12 A. Yes. 13 Q. Did you see any evidence of those in those papers? 14 A. No, I didn't. 15 Q. Do you see that there are some footnotes, for example 16 Hoffmann, there's a tiny footnote B against 0.1 to 0.5 17 millisieverts? Can you turn, please, to page 5. 18 A. Yes. 19 Q. Can you see under the table, footnote B, and can you 20 read that out, please? 21 A. The whole of it? 22 Q. No, no, it's hard to see but there's a little a and 23 then -- 24 A. Oh, yes. 25 Q. -- you see it says, "These dose are taken from figures 1</p> <p style="text-align: center;">Page 113</p>	<p>1 MR JUSTICE BLAKE: Right. That completes your evidence. 2 Thank you very much for coming and you can now go. 3 THE WITNESS: Thank you. 4 (The witness withdrew) 5 MR HEPPINSTALL: My Lord, I wonder if we might have 6 an earlier than usual lunchtime adjournment? 7 MR JUSTICE BLAKE: Yes, we can. 8 MR HEPPINSTALL: I am most grateful. 9 MR JUSTICE BLAKE: I am anxious that -- assuming there is 10 a good degree of confidence about the progress we're 11 making -- we finish this afternoon at some point between 12 3.30 and 4.00. 13 MR HEPPINSTALL: I am in other's hands. 14 MR TER HAAR: I hadn't expected to start Mr Hallard today. 15 I have plenty to ask him. So I would be very happy to 16 rise at 3.30 today. Apart from the fact that it's 17 Friday. 18 MR JUSTICE BLAKE: Yes, well there are other things that 19 I have to keep my eye on before I go home, so it's not 20 that I'll be on -- you know. 21 MR TER HAAR: So I would be happy to make a start and also 22 happy to have that bit of extra leeway. 23 THE WITNESS: I just wanted to warn somebody. I've taken 24 two things out of the bundle which need replacing. 25 MR JUSTICE BLAKE: Unless you want to hear about how we are</p> <p style="text-align: center;">Page 115</p>
<p>1 and 3"? 2 A. "These doses are taken from figures 1 and 3 of Savchenko 3 and represent the mean countrywide first year (ICRP) 4 committed effective dose." 5 Q. Now, if you look at all the doses in table 1, I think 6 the vast majority of them have a little b against them. 7 So are we to presume that what's happened -- well, you 8 tell me what you think -- 9 A. Basically, I suspect what they've done, without going 10 back to check the Savchenko paper, is they have assumed 11 a dose from the dose that has been taken from the ground 12 dose. 13 Q. So these doses don't come from the actual papers cited, 14 they've all been taken from another source? 15 A. Yes. And I doubt, actually, in the individual papers, 16 whether you would have had sufficient data to know where 17 all of these different populations were resident. So 18 I think that's a very insecure thing to have done. 19 Q. Well, my last question is do you think that that's 20 a safe or an unsafe basis from which you can draw the 21 conclusion in the abstract, "Using Chernobyl data we 22 derive an excess relative risk for all malformations of 23 1.0 per 10 millisievert cumulative dose"? 24 A. I think it is extremely unsafe. 25 MR HEPPINSTALL: No further questions.</p> <p style="text-align: center;">Page 114</p>	<p>1 going to organise this afternoon, do head back, I am 2 sure you have other things to do. 3 THE WITNESS: Thank you. 4 MR JUSTICE BLAKE: Yes. Do you want to start at 2.00 or do 5 you need a little bit more time? 6 MR TER HAAR: I don't need any more time than that, no. 7 Half past one or two, as suits the Tribunal. 8 MR HEPPINSTALL: I was seeking the usual hour. If 9 Mr ter Haar would like more. 10 MR JUSTICE BLAKE: Okay. If we rise now and we come back at 11 half past one and then we can break by 3.30. Is that 12 going to work? 13 MR TER HAAR: It seems to me it will. 14 MR JUSTICE BLAKE: Yes. We can give our stenographers 15 a break some time halfway through that period. 16 (12.30 pm) 17 (The short adjournment) 18 (1.30 pm) 19 MR HEPPINSTALL: My Lord, before I call Mr Hallard I should 20 like to draw something to the Tribunal's attention. 21 Professor Thomas, before giving her evidence earlier in 22 the month on 20 May received some e-mails that she drew 23 to the Secretary of State's attention. She didn't want 24 us to pass those on to the Tribunal. However, she did 25 receive a further e-mail on 17 June, i.e. today, at</p> <p style="text-align: center;">Page 116</p>

<p>1 9.40, just before she was due to give her evidence, 2 which she was concerned about and was upset about. She 3 would like me to draw those your attention. We have 4 copies for you. 5 MR JUSTICE BLAKE: Yes. (Handed). 6 MR HEPPINSTALL: Like all e-mails they are in reverse order 7 so you will have to go right to the back to see the 8 chain. The first e-mail was from a Major Alan Batchelor 9 to Professor Thomas, copying in Dr Busby, 10 a Mr David Whyte, who I believe is an appellant in the 11 NTV group of appeals, not this group but the wider 12 group, and also Mr Andrew Ades. 13 The second e-mail is from Dennis Hayden to the same 14 circulation list. 15 Then an e-mail that particularly upset 16 Professor Thomas before she gave evidence this morning 17 is one circulated to her junior staff just before she 18 came into court this morning. 19 Now, the Secretary of State, because we do not know 20 precisely who these people are, nor the precise details 21 of the matters that are set out in the e-mail, makes no 22 allegation or point about these e-mails save that (1) 23 Professor Thomas would like the Tribunal to know she was 24 particularly personally upset by the e-mail she received 25 immediately before she gave evidence this morning. She</p> <p style="text-align: center;">Page 117</p>	<p>1 this Tribunal, action will be taken. 2 MR JUSTICE BLAKE: Yes, thank you. I have only just glanced 3 at it. Obviously in the Internet age -- 4 MR HEPPINSTALL: Indeed, my Lord. 5 MR JUSTICE BLAKE: -- people's e-mails and social media, if 6 one is foolish enough to have one, for which I can speak 7 for the generation that doesn't, can be polluted by 8 trolls. But when it comes to adverse comments to 9 a witness before a court or a tribunal, who is doing 10 their best, then criticisms which are intemperate and 11 personal and intimidatory are capable of amounting to 12 a contempt. 13 MR HEPPINSTALL: Indeed, my Lord. 14 MR JUSTICE BLAKE: I am glad to know that you will refer 15 these matters for appropriate consideration. I would 16 seek to protect any witness of any side appearing before 17 this Tribunal who was the subject of contumacious 18 comment, but I don't need to. 19 MR HEPPINSTALL: I am grateful, my Lord. 20 I now call Mr Hallard, please. 21 MR RICHARD HALLARD (sworn) 22 Examination-in-chief by MR HALLARD 23 MR JUSTICE BLAKE: Right. I think we are going to be 24 a couple of hours this afternoon. We are going to up 25 stumps around about 3.30. Do you want to stand or do</p> <p style="text-align: center;">Page 119</p>
<p>1 asked you to note the people who are copied into that 2 e-mail. We have met some of the characters before in 3 the proceedings. Mr Paul Dorfman was involved in the 4 CERRIE report. Mr Richard Bramhall you've heard from in 5 evidence, and Dr Chris Busby is also listed in that 6 circulated list. As I say, she was particularly upset 7 personally this morning because it is addressed to 8 a junior member of her staff. 9 That's the first point. 10 The second point, my Lord, is that the 11 Secretary of State will take action, whether is 12 referring matters to the Attorney-General or in the 13 Divisional Court in the aid of the execution of this 14 jurisdiction, because this jurisdiction has no contempt 15 of court -- 16 MR JUSTICE BLAKE: We don't have contempt powers, no. The 17 most I could do would be to refer this correspondence to 18 the Attorney-General. 19 MR HEPPINSTALL: Indeed, or we could start a civil claim for 20 contempt in the civil court. However, we're not making 21 an allegation or taking any action in respect of these 22 e-mails. But if there is any escalation or future 23 e-mails which do cross the line into witness 24 intimidation of any witness, whether it be the 25 Secretary of State's or any other party's witness before</p> <p style="text-align: center;">Page 118</p>	<p>1 you prefer to sit? 2 A. I'll start standing, my Lord, and I'll probably sit 3 later on if that's okay. 4 MR JUSTICE BLAKE: Yes, please, whatever makes you more 5 comfortable in order to give your evidence. 6 A. Thank you. 7 MR JUSTICE BLAKE: Just give me a moment. 8 MR HEPPINSTALL: If you could pull out SB2, please. 9 Tab 2.14, please. Is that your first report to this 10 Tribunal? 11 A. Yes, it is. 12 Q. If you turn to the last page, page 285, you there signed 13 the expert's statement of truth. Is that still the case 14 today? 15 A. Yes. 16 Q. And you then answered some questions and produced 17 a supplementary report on 5 May 2016 which I think is at 18 2.15; is that right? 19 A. It is. 20 Q. And then the report where you were answering questions 21 is at 2.17; is that right? 22 A. Yes, it is. 23 Q. It is. Then you followed that up with a further 24 supplementary report of 5 May and that's what's at 2.15. 25 A. Yes, that's correct.</p> <p style="text-align: center;">Page 120</p>

1 MR HEPPINSTALL: If those three reports could stand as this
 2 witness' evidence-in-chief, my Lord, I have no further
 3 questions.
 4 MR JUSTICE BLAKE: Thank you.
 5 Cross-examination by MR TER HAAR
 6 MR JUSTICE BLAKE: Yes.
 7 MR TER HAAR: Mr Hallard, good afternoon. I think you've
 8 been sitting through the whole or most of the
 9 proceedings?
 10 **A. Most of the proceedings.**
 11 Q. Have you given evidence before or is this your first
 12 time?
 13 **A. It's my first time.**
 14 Q. Could we just look at your CV which we have in bundle
 15 SB2 at tab 2.14 at page 283.
 16 Part of what I want to do with you is just to try to
 17 make sure that we can understand what your professional
 18 experience is and how that fits in with some of the
 19 other experts in this case. There's one thing which
 20 undoubtedly is clear; that you have very considerable
 21 experience in the nuclear industry because that has been
 22 the whole of your working life?
 23 **A. Most of it, yes.**
 24 Q. Can we start with the second page of your CV, that's
 25 page 284. Right at the bottom: Durham University, BSc

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1 with honours in applied physics?
 2 **A. Yes.**
 3 Q. Was that specifically in medical or health physics?
 4 **A. No, it wasn't. It was in general physics and**
 5 **electronics, that kind of thing, so it was more general**
 6 **physics.**
 7 Q. Because medical physics, for example, is a specialist
 8 subset of natural sciences in itself, isn't it?
 9 **A. It is, I believe, yes.**
 10 Q. And the sort of specialties you find within the world of
 11 medical physics are people for example who are members
 12 of world watchdog committees, that sort of thing; you
 13 agree with that?
 14 **A. Erm --**
 15 Q. That's one area of activity carried out by medical
 16 physicists?
 17 **A. I would -- I believe so. I don't think you would have**
 18 **to come from that background if that answers your**
 19 **question. But that would certainly be one source of**
 20 **people from that area.**
 21 Q. I was thinking it is more the other way round. One of
 22 the activities which medical physicists carry out is
 23 assisting on world watchdog committees?
 24 **A. I don't think I know the answer to that question.**
 25 **I think it's probably true but I don't know the answer**

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1 **to that question.**
 2 Q. I'm a little surprised because I would have thought as
 3 we go through it one of the things you have to do for
 4 the various functions you've been carrying out over the
 5 years is to take on board received wisdom as to concerns
 6 about in particular occupational hazards which come from
 7 such bodies as world watchdog committees?
 8 **A. Oh yes, that's certainly true. It's just the link**
 9 **between would -- I think you were implying that people**
 10 **from a medical physics background would go into watchdog**
 11 **bodies and I think that's probably true but I've never**
 12 **actually looked at that link, but certainly I'll look at**
 13 **the output from watchdog bodies.**
 14 Q. You yourself have never sat on a watchdog committee or
 15 anything of that sort, have you, according to your CV?
 16 **A. No, I think in the context that you are referring to**
 17 **there, no, I don't think so. I have been involved with**
 18 **committees, so working with the Health and Safety**
 19 **Executive, for example, to assist in providing feedback**
 20 **to the draft European Union directive on the basic**
 21 **safety standards. But that I don't think is what you**
 22 **are referring to by a watchdog body.**
 23 Q. No, it's not. The reason I ask is this. Watchdog
 24 committees exist for most of the major industries of the
 25 world, don't they?

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1 **A. Yes.**
 2 Q. Including obviously the nuclear industry and other --
 3 I say nuclear industry, but other bodies concerned with
 4 the use of radioactive materials?
 5 **A. Yes.**
 6 Q. And what is important with a watchdog committee, exactly
 7 as the name suggests, is to take cognisance of
 8 hypotheses which are coming forward in order to see
 9 whether they may be an indicator of the need to revise
 10 consensus opinion. Would you agree with that?
 11 **A. Yes, that would be one of their roles.**
 12 Q. Now, I'll come back to your CV in a moment, but if we
 13 just take your lifetime in the nuclear industry, it goes
 14 back 40 or 50 years --
 15 **A. 40 -- about 40 years.**
 16 Q. During that time there's been enormous progress on many
 17 interrelated fields. For example we know more about DNA
 18 than we did 40 years ago?
 19 **A. Yes.**
 20 Q. We know more about damage, potential damage to DNA than
 21 we did 40 years ago. You would agree those are examples
 22 of the sort of general progress that's made in science
 23 which has implications for the nuclear industry?
 24 **A. Yes.**
 25 Q. What I suggest is that the sort of watchdog committees

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1 of the sort I mentioned are looking to see if some
 2 scientist comes up with a plausible hypothesis which
 3 might need further investigation. It may not yet be
 4 proved but it's the first seeds of an idea which grows
 5 and you're familiar with that sort of process?
 6 **A. Yes.**
 7 Q. How in your experience does a body such as Sellafield,
 8 with which you've been concerned, take on board the fact
 9 that perhaps a scientist in Australia has identified
 10 what may be a concern that has not yet been carried
 11 through the full process of research, controls,
 12 et cetera, in order to see whether the concern is
 13 a genuine one?
 14 **A. You ask specifically about how would -- well, Sellafield**
 15 **you mentioned but say another site, any site --**
 16 Q. I mentioned Sellafield because that's where you've been.
 17 **A. Yes.**
 18 Q. But I'm not limited to that. I'm really looking at how
 19 the nuclear industry takes on board the fact that
 20 somebody may have an idea, the implications of which may
 21 be enormously important for the health of the workforce.
 22 How does that work in practice?
 23 **A. The principal way it would work would be through**
 24 **legislation. So if a new idea comes forward that would**
 25 **then be considered by the -- well, by Public Health**

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1 **England now. Formerly that would have been the Health**
 2 **Protection Agency and then before that it would have**
 3 **been the National Radiological Protection Board.**
 4 **I merely mention that because some of those acronyms,**
 5 **NRPB, for example, have appeared in some of the past**
 6 **papers. So that as an organisation would look at those**
 7 **ideas, analyse them technically. They would then come**
 8 **forward with recommendations. It would also be -- and**
 9 **principally actually it would be looked at through the**
 10 **ICRP, the International Commission on Radiological**
 11 **Protection, which I think is an acronym, ICRP, that**
 12 **we've also heard a number of times. They would look at**
 13 **the papers, they would look at the technical background**
 14 **to the work which had been done. That would then go**
 15 **forward in the form of recommendations from the ICRP**
 16 **which would be evaluated by Public Health England,**
 17 **amongst others. They would be evaluated by the**
 18 **International Atomic Energy Agency.**
 19 **Ultimately, after some period, that would then come**
 20 **through in the form of what are called basic safety**
 21 **standards, both from the IAEA and also the European**
 22 **Union draft directive, based on recommendations which**
 23 **had come from the ICRP. Those would then come forward**
 24 **in the form of national legislation which would**
 25 **ultimately be implemented in the UK by legislation, by**

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1 **regulations called the ionising radiations regulations.**
 2 **Those current regulations were issued -- they are**
 3 **the ionising radiation regulations 1999 which were**
 4 **issued at the start of the year 2000. There will be or**
 5 **there are likely to be another set of ionising radiation**
 6 **regulations in the next few years which will implement**
 7 **the recommendations from the last set of major**
 8 **recommendations from ICRP which was ICRP/103.**
 9 **That's what it's called, the document. The annals**
 10 **of the ICRP, volume 103.**
 11 Q. So obviously we heard from Professor Thomas -- and it
 12 makes sense, we've seen it from documents -- that
 13 running something like a power station, as a manager you
 14 need to have really levels, you need to have
 15 a threshold, you need to say "This is safe, this is
 16 unsafe" and you balance the risks against what has to be
 17 done?
 18 **A. Can I qualify that slightly? There are three principles**
 19 **in ICRP which were established several decades ago and**
 20 **the three principles are known as justification,**
 21 **optimisation and limitation. Sorry, this I think is**
 22 **relevant to your question.**
 23 **Justification means that any practice, that any**
 24 **operation if you like which involves exposure to**
 25 **ionising radiation must be justified, so that the**

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1 **benefit must exceed the detriment, the cost, if you**
 2 **like, but that's the cost in its broadest terms, in**
 3 **terms of health, financial cost and other costs at the**
 4 **time.**
 5 **The second, which is the point I really want to make**
 6 **in answer to your question, is optimisation.**
 7 **Optimisation is something which I think will be very**
 8 **familiar to the court. The principle of optimisation is**
 9 **that radiation levels must be reduced to as low as**
 10 **reasonably practicable, ALARC.**
 11 **And the third, which I'll just complete, but then**
 12 **I'll go back to optimisation, and the third principle,**
 13 **limitation, says: regardless of the other two, the dose**
 14 **of radiation must be less than certain numbers.**
 15 **I'm sorry, I wasn't sure if this is what you meant**
 16 **but I did infer from your question that perhaps you were**
 17 **thinking about the dose limits.**
 18 **The optimisation principle, if I may just finish**
 19 **that, says that regardless of the limits, the exposure**
 20 **to radiation must be reduced to a level which is as low**
 21 **as reasonably practicable. And that is probably -- that**
 22 **principle has probably had more to do with reducing the**
 23 **radiation doses in both medicine and the nuclear**
 24 **industry and academia than any other single factor, more**
 25 **so than limits.**

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1 MR JUSTICE BLAKE: So an absolute limit is part of it but
 2 it's not the whole story?
 3 **A. Exactly.**
 4 MR TER HAAR: It's a very simple point. For certain
 5 purposes you set and have regard to thresholds? There
 6 may be other qualifications but in broad terms you would
 7 set and have regard to thresholds, yes?
 8 **A. Limits. I am not quite sure what you mean by**
 9 **"threshold" in that context.**
 10 MR JUSTICE BLAKE: What's the difference between a threshold
 11 and a limit?
 12 MR TER HAAR: I don't think there is, but let's put it this
 13 way. For certain purposes you say: "I do not want my
 14 workforce to be exposed to more than a set figure of
 15 radiation"?
 16 **A. Yes, that's correct.**
 17 Q. I'm not on a sophisticated scientific basis. I'm trying
 18 to just make a very, very general point at the moment.
 19 **A. It's just that the term "threshold" tends to mean**
 20 **something else in radiation protection and I just I**
 21 **think misunderstood your question.**
 22 Q. I'm not using specialist language at the moment.
 23 **A. I understand.**
 24 Q. The process which you describe through legislation is
 25 one which may result in what I call a threshold, in the

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1 broad sense I've just used it, being reduced; you agree?
 2 **A. Yes.**
 3 Q. And I think what you described is what can be a very
 4 lengthy period from my hypothetical Australian scientist
 5 coming up with a hypothesis to a consensus being reached
 6 scientifically, leading to the ICRP agreeing with that
 7 consensus, leading to the national legislation. That
 8 can be a very substantial gap in time, can't it?
 9 **A. It can. I think if there are particular concerns that**
 10 **are raised, the process will tend to work more quickly.**
 11 **Can I give you an example of something which has**
 12 **occurred in the past relatively small number of years.**
 13 **The current limit for the eye lens from memory is**
 14 **150 millisieverts. There has been particularly one**
 15 **paper, and I think it may now be supported by more than**
 16 **that, which has indicated that that level may now not be**
 17 **appropriate. The risk to the lens of the eye is**
 18 **a cataract and the paper has proposed that cataracts can**
 19 **occur at lower doses. As a result of that there is**
 20 **a recommendation which has come out of ICRP which has**
 21 **only come out in the past small number of years,**
 22 **I think, which has now, if my memory serves me**
 23 **correctly, been incorporated. It was introduced into**
 24 **the draft basic safety standard and is now incorporated**
 25 **into the safety standards. So that the basic safety**

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1 **standard now, the European basic safety standard, if my**
 2 **memory serves me correctly, does now incorporate the**
 3 **lower limit which is 20 millisieverts for the eye lens.**
 4 **So that would be the limit that would go forward into**
 5 **the legislation.**
 6 **Implementation of that will take a little time.**
 7 **It's not actually an issue, as I understand it, for the**
 8 **nuclear industry, it's more an issue for the medical**
 9 **profession -- surgeons and people who work with live**
 10 **X-ray images of patients, catheter tubes and things like**
 11 **that. I understand that that is where the pressure will**
 12 **come from particularly that their doses can exceed 20**
 13 **millisieverts. So there will have to be more work done**
 14 **in terms of how that dose is measured, and how that is**
 15 **then controlled in the future. I think that work is**
 16 **ongoing at the moment.**
 17 Q. Just give us an idea. That I think you say is
 18 an example of where something moves a little faster than
 19 perhaps in other circumstances?
 20 **A. Yes.**
 21 Q. How long has it taken, just so the Tribunal get an idea,
 22 from the first paper suggesting that the present -- I'll
 23 call it a threshold -- I don't want that to be a loaded
 24 word -- but the present 150, I think you said, should be
 25 reduced to 20? How long has that taken as a process?

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1 **A. It's not formally a limit yet. It won't formally be**
 2 **a limit until it comes into legislation.**
 3 MR JUSTICE BLAKE: The safety standard?
 4 **A. The safety standards, yes.**
 5 MR TER HAAR: How long has it taken so far to get to the
 6 point where we haven't got a safety standard?
 7 MR JUSTICE BLAKE: We have a safety standard but we haven't
 8 got legislation in force.
 9 MR TER HAAR: Sorry.
 10 **A. A number of years. I am just trying to think if I can**
 11 **estimate that more closely without being misleading.**
 12 MR JUSTICE BLAKE: "A number of years" is an answer. You
 13 can't -- at the moment you are not sure.
 14 **A. I couldn't give you a precise number. It's a number of**
 15 **years, which I think will be smaller than 10. But I'm**
 16 **not sure about that. I would need to check on that.**
 17 MR TER HAAR: I'll come back to why I asked those questions
 18 a little later.
 19 Can we go back to your CV then.
 20 **A. Yes.**
 21 Q. Don't get me wrong. In the area in which you've been
 22 operating I've absolutely no question that you know your
 23 stuff, right? I want to find out what the limits are on
 24 that.
 25 So you left university, and took employment as

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1 a safety adviser in 1976 and we see that three years.
 2 You don't mention any specialist training.
 3 Presumably you had some form of training in order to
 4 enable you to carry out your job as a safety adviser?
 5 **A. Yes, I did.**
 6 Q. Would that have been scientific training or would it
 7 have been practical: don't let people out without this
 8 suit on or those goggles on? What would be the nature
 9 of the training at that stage?
 10 **A. It would've been both those things.**
 11 Q. Just give us an idea.
 12 **A. I think particularly in the context you are asking the**
 13 **question, I attended two one-month training courses at**
 14 **what was then the National Radiological Protection**
 15 **Board, separated by about two years. So after I joined**
 16 **Sellafield, a short period after that I attended**
 17 **a one-month training course at the NRPB on health**
 18 **physics, and then I think a small number of years after**
 19 **that I attended another one, the advanced month training**
 20 **at the NRPB, again in health physics.**
 21 Q. The Tribunal may well know this, particularly the
 22 medical member, but what does health physics cover?
 23 **A. I think the simplest way to explain it is it's**
 24 **radiological safety. It's the -- it's -- it's -- well,**
 25 **just that: radiological safety. It is to understand the**

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1 **principles of radiation protection and also to advise --**
 2 **in my case advise plant managers on how they should**
 3 **control and minimise doses on their plants.**
 4 Q. And health physics appears to have been your special
 5 subject. Certainly it looks like promotion is going on:
 6 1982 to 1986, health physics shift manager; 1986 to
 7 1990, health physics area manager. And RPA?
 8 Radiological protection adviser would that be?
 9 **A. Yes, that's correct.**
 10 Q. This is presumably mainly internal, is it, to the
 11 various power plants that you were working with?
 12 **A. No. I mentioned a few minutes ago the ionising**
 13 **radiation regulations, 1999. The radiation protection**
 14 **adviser, the RPA, is a specific role identified in the**
 15 **ionising radiation regulations. It's someone who is**
 16 **appointed to advise the employer at Sellafield, in my**
 17 **case, on the implementation of the ionising radiation**
 18 **regulations.**
 19 **Now, that -- do you want me to explain what the**
 20 **process is for that?**
 21 Q. Please do. If you can do it briefly but I would be
 22 grateful to learn.
 23 **A. Sure. It's a two-stage process. The first stage is**
 24 **that the applicant, me in this case, would put forward**
 25 **a portfolio, quite a lengthy portfolio, which would**

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1 **describe both my technical training, so I mentioned the**
 2 **two courses, for example, that I described a few minutes**
 3 **ago, other technical training and there is effectively**
 4 **a list of topics which needs to be covered as part of**
 5 **that technical training.**
 6 **The portfolio also needs to explain and identify**
 7 **your knowledge and experience in a number of other**
 8 **topics which are associated with the ionising radiation**
 9 **regulations. So ALARC would be one of them. What**
 10 **experience have you with ALARC? What is your knowledge?**
 11 **So papers that you've produced, any other documents that**
 12 **you've produced would go into the portfolio.**
 13 **In my case the process was that would then go**
 14 **forward to -- the portfolio, which is quite substantial**
 15 **in my case, the portfolio would then go forward to**
 16 **an assessing body. I was actually also an assessor on**
 17 **that assessing body but I was also assessed by other**
 18 **people, clearly. And I was then interviewed by that**
 19 **assessing body. They'd already looked at my portfolio**
 20 **and then I was interviewed -- I can't remember, perhaps**
 21 **an hour or maybe longer -- interviewed by the assessing**
 22 **body, and they then made a judgment as to whether I'd**
 23 **reached the appropriate level of competence in terms of**
 24 **the technical requirements and knowledge of the ionising**
 25 **radiation regulations.**

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1 **If you reach that stage, and it was found that I had**
 2 **reached that, you're then considered to be competent.**
 3 **The second stage is you then have to be appointed by**
 4 **your employer to do a specific job because clearly the**
 5 **competence can be -- well, the competence is generic.**
 6 **But your ability to advise an employer specifically**
 7 **requires that you have additional knowledge and**
 8 **experience of the particular area where you are working.**
 9 **In my case that would be particular plants. In the**
 10 **medical profession because clearly, as I suspect you are**
 11 **familiar with, there are also medical RPAs and they**
 12 **would need to be appointed by a hospital to ensure that**
 13 **they had the appropriate experience and knowledge to be**
 14 **able to advise the hospital on specific areas -- X-rays,**
 15 **X-ray investigations, that kind of thing, and X-ray**
 16 **therapy, radiation therapy. It's a two-stage process.**
 17 Q. I think my question -- that's very helpful -- was not
 18 quite answered by your answer.
 19 **A. Right.**
 20 Q. What I was asking you was this. Your sphere of
 21 operation -- and we're still at the moment dealing with
 22 the period up to 1990 by which time you become a health
 23 physics area manager and an RPA -- your area of
 24 operation perhaps is one way of putting it was within
 25 the particular nuclear power plants that you were

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1 concerned with?
 2 **A. My sorry?**
 3 Q. Was within the particular nuclear power plants --
 4 **A. My field of operation or my field of knowledge?**
 5 Q. Field of operation.
 6 **A. Field of operation, yes.**
 7 Q. Can I just ask so far as that's concerned, obviously the
 8 whole reason for your being there is that there are
 9 recognised dangers involved with a nuclear power plant?
 10 **A. Yes.**
 11 Q. Would I be right in thinking as a result of that the
 12 monitoring systems in every square inch of the nuclear
 13 power plant are very extensive indeed?
 14 **A. Yes, they are. Just one point of clarification, and**
 15 **sorry, I may be being pedantic here but just to be**
 16 **clear, although there were two operating power plants**
 17 **when I first joined Sellafield, Calder Hall was one of**
 18 **them and that continued to operate for a while and I did**
 19 **have some limited involvement in that, most of my**
 20 **operations were actually on the reprocessing point, just**
 21 **for clarity.**
 22 **But yes, the point of your question is there would**
 23 **have been -- or there were, sorry -- installed equipment**
 24 **for various types of monitoring for sampling the air**
 25 **activity, monitoring the air activity, monitoring for**

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1 **contamination and human monitors would regularly go**
 2 **round the different parts of the plant to assess the**
 3 **levels of radiation and contamination on those plants.**
 4 Q. Don't get me wrong. I'm sure that some cases go through
 5 the courts where people are criticising what has been
 6 measured and what hasn't. I'm not in that area. I'm
 7 just establishing the fact that clearly you have
 8 a potentially health-threatening industry, you are doing
 9 your best to keep the health risks to the minimum
 10 possible or reasonably practicable, and therefore part
 11 of that is to have very extensive monitoring so that you
 12 have a really accurate database of information. Would
 13 that be fair?
 14 **A. Yes. It was less so on the older plants which I first**
 15 **worked on. The newer plants which I worked on later**
 16 **that's -- yes, we had very extensive monitoring.**
 17 **The earlier, the older plants which had been in**
 18 **operation for some time when I joined the site, yes,**
 19 **there was monitoring but it was not of the same level of**
 20 **sophistication.**
 21 Q. In a sense that answer anticipates -- obviously as
 22 health concerns in society grow and as technological
 23 advances occur, the standard of monitoring becomes more
 24 and more -- I'm not sure if the word "detailed" is the
 25 right word, but extensive?

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1 **A. Yes, and sophisticated.**
 2 Q. And sophisticated?
 3 MR JUSTICE BLAKE: I also take it that the switch you
 4 mentioned to reprocessing was because Sellafield was
 5 moving from creating power into reprocessing spent fuel,
 6 was it?
 7 **A. Sellafield has always been a reprocessing site, my Lord,**
 8 **but there is also -- there were reactors on that site as**
 9 **well. The first reactors were there purely for military**
 10 **purposes. The later reactors were civilian reactors.**
 11 MR JUSTICE BLAKE: Right.
 12 MR TER HAAR: Just moving from monitoring the atmosphere,
 13 the air, et cetera, was there also a programme of health
 14 monitoring of employees?
 15 **A. Yes.**
 16 Q. It may be that those also became more sophisticated but
 17 let's take it at when you first went into the industry
 18 in 1976. Would monitoring of employees already have
 19 been taking place at that time?
 20 **A. Yes. The principal monitoring, I'm just trying to think**
 21 **back now it's a long time ago, would have been by using**
 22 **what was called a film badge at the time. This was**
 23 **a blue badge that people may have seen, it's quite**
 24 **commonly photographed, which contains a small piece of**
 25 **effectively photographic emulsion, and you can assess**

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1 **the level of radiation that's been received by the**
 2 **wearer from the patterns which are on the photographic**
 3 **emulsion when it is developed. I can expand on that if**
 4 **required. But that is a way of measuring the external**
 5 **radiation.**
 6 **There was also some internal radiation monitoring.**
 7 **Initially that would -- well, perhaps rather than going**
 8 **to the detail, there was some internal monitoring but**
 9 **that became more sophisticated over the years.**
 10 Q. Well, let's just -- it may be easier to come forward in
 11 time and then go back.
 12 **A. Right.**
 13 Q. Would it now be standard practice, for example, to take
 14 urine samples and blood samples from employees?
 15 **A. Not blood samples.**
 16 Q. But urine samples?
 17 **A. Urine samples.**
 18 Q. And --
 19 **A. From people who were working on specific plants. The**
 20 **urine sampling would have been, from memory -- it is**
 21 **five or so years, five or six years perhaps now since I**
 22 **left the site, but the urine sampling for people would**
 23 **be focused principally on the plutonium plants, people**
 24 **working on plutonium plants, looking principally for**
 25 **plutonium in urine. I think there was also other urine**

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1 **sampling going on, but actually I'm struggling a little**
 2 **bit to remember that now with any certainty.**
 3 Q. So there came a time -- again the exact date doesn't
 4 matter -- there came a time when it became standard
 5 practice to take urine samples from those who might be
 6 exposed to plutonium?
 7 **A. Yes.**
 8 Q. It I think follows from that answer that that's regarded
 9 as being the best indicator of internal contamination in
 10 a practical way. All right?
 11 **A. Yes, it is. It's not the only way. There were other**
 12 **forms of monitoring which were done. I mean I can**
 13 **explain what those were as well.**
 14 Q. If you can do it shortly. Certainly for my purposes
 15 I don't need a scientific exposition but just a broad
 16 guide as to what was going on.
 17 **A. There was a period when the new legislation was**
 18 **introduced when everyone who was working in what was**
 19 **known as a controlled area, the areas where the people**
 20 **were working on the processing plants wore small air**
 21 **samplers, called personal air samplers, which was**
 22 **a small sample paper which was positioned on the lapel**
 23 **close to the breathing zone. The air was drawn in**
 24 **through that and any particles of activity would be**
 25 **deposited on the filter card, filter paper, which would**

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1 **then be counted. That is a very sensitive way of**
 2 **assessing the intake, rather than the uptake, to make**
 3 **that distinction. I can explain those two terms.**
 4 MR JUSTICE BLAKE: Could I just go back to urine just whilst
 5 we are on the topic.
 6 **A. Certainly.**
 7 MR JUSTICE BLAKE: One might think -- I might be wrong, you
 8 will tell me if I am -- that urine is comparatively
 9 a simple way of taking a sample?
 10 **A. It is. People are asked to -- without getting into the**
 11 **graphic details, they are asked to give -- I think it's**
 12 **a litre, a 1 litre sample, and they will fill a bottle**
 13 **over the space of a week or so and that will go for**
 14 **analysis.**
 15 MR JUSTICE BLAKE: How often do they do it?
 16 **A. Again it would depend on the nature of the work.**
 17 **I think from memory it would be done every quarter.**
 18 MR JUSTICE BLAKE: Right.
 19 **A. That's from memory.**
 20 MR JUSTICE BLAKE: But it doesn't require a doctor to take
 21 a blood sample?
 22 **A. No, no, the person fills up a sample bottle and that is**
 23 **then taken away for analysis.**
 24 **If someone is thought to have -- if there is a risk**
 25 **that somebody may have received an exposure, an internal**

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1 **exposure to plutonium they would also be asked to give**
 2 **urine samples. Actually they will also be asked to give**
 3 **faecal samples too, so that's another form of sampling**
 4 **but that's a specific investigation.**
 5 MR TER HAAR: And is there any form of continuing screening
 6 of people once they've left the employment of whichever
 7 company at that point in time owns -- British Nuclear
 8 Fuels or whoever it might be is the owner from time to
 9 time? Is there a continuing process of post-employment
 10 monitoring?
 11 **A. No. I think in the way that you mean that, no, there**
 12 **wouldn't be. So the sampling would be done by the**
 13 **employer. When the person leaves, and of course I have**
 14 **one of these, the individual's radiation dose that they**
 15 **have accumulated on the site is sent to them in a letter**
 16 **so that the individual will know what their accumulated**
 17 **dose has been. But there is no specific follow-up that**
 18 **I'm aware of.**
 19 **There may be individual cases where that would be**
 20 **done in a special case but I'm not sure of that. That**
 21 **last point I think is an assumption or a speculation on**
 22 **my part. I couldn't say that with any certainty.**
 23 Q. Now going back to the question I was asking you about,
 24 the time it takes for a hypothesis to get all the way
 25 through to reflecting itself in legislation, which we

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1 gather can be a period of years, I imagine that the
 2 monitoring regime of the nuclear industry that you were
 3 involved in will take into account changing scientific
 4 consensus about what you need to be watching out for, to
 5 put it in broad terms?
 6 **A. Yes.**
 7 Q. So if we take ourselves back to the 1950s, one of the
 8 things which I think you may be able to agree with me
 9 about is that if we look at the control regime as
 10 operated on Christmas Island for these various nuclear
 11 tests it wouldn't stand up for a second by modern
 12 standards, would it?
 13 **A. In terms of the monitoring procedures, the internal**
 14 **monitoring procedures, no, it would be -- it would be**
 15 **simpler. I think there was urine sampling going on in**
 16 **AWRE, I believe. I think there is reference to that**
 17 **made in some of the documents. Some of the monitoring**
 18 **controls that I've observed, particularly the control**
 19 **regimes around the balloon burst, the atomic weapons, so**
 20 **that's Grapple Z1 and Grapple Z4, I've looked at that.**
 21 **There is actually a film of that which is held by the**
 22 **Imperial War Museum which is available online and I've**
 23 **looked at their control regimes at the boundary of the**
 24 **-- again it's called the controlled area, the point**
 25 **where -- I think it's self-evident from the name -- at**

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<p>1 one side you have no control, the other side you have 2 controls. The boundary and the control at the boundary 3 is clearly very important in terms of people being 4 monitored with showering facilities and changing 5 facilities. 6 The facilities that I've seen for Grapple Z1 and 4 7 were actually I thought quite impressive. The 8 instrumentation looked very old, clearly, but in terms 9 of the contamination monitoring, the surface 10 contamination monitoring on the individuals I'm talking 11 about, and on the vehicles I thought was done to a high 12 standard from what I could see on that film. 13 Q. Well, I'll come back to that. But certainly so far as 14 internal contamination is concerned, what you might 15 think in today's terms of a perfectly standard process 16 of taking urine samples simply doesn't appear to have 17 been done for any of the soldiers that we are aware of? 18 A. No, I've seen no evidence of that whatsoever. I've 19 looked for it and I'm pretty sure that that's the case. 20 Q. Standards change, of course, but by today's standards 21 that would be an astonishing omission, wouldn't it? 22 A. Well, you would still need to assess whether people 23 would need the urine sampling and you would still do 24 an assessment based on whether somebody was likely to be 25 exposed. Perhaps I could amplify that slightly, again</p> <p style="text-align: center;">Page 145</p>	<p>1 testing, the health testing of the veterans as they now 2 are, the young men as they then were on 3 Christmas Island, was based upon assumptions as to who 4 would be affected and who wouldn't. That's a fair 5 summary, isn't it? 6 A. Yes, I would perhaps say that it was based on judgments 7 but nevertheless there were -- the number of people on a 8 film badge issue was a relatively small proportion of 9 the whole. I think the number of people on urine 10 sampling -- I'm less certain about the urine sampling 11 because it's just things I've picked up from passing 12 references in documents. The amount of urine sampling 13 going on was very limited and I think it was specific to 14 the AWRE personnel. 15 Q. It was the boffins who got tested and not the 16 conscripts? 17 A. I believe that that was still based on the judgment that 18 they were more likely to be exposed because of the 19 nature of their work. Particularly back in Aldermaston, 20 of course they would have been involved in working with 21 plutonium specifically, and therefore the level of risk 22 of exposure would have been significantly higher and 23 that would therefore inform the judgment as to whether 24 urine sampling was needed. 25 Q. Now, I am going to spell out perhaps the blindingly</p> <p style="text-align: center;">Page 147</p>
<p>1 to explain how it would happen on a modern site because 2 otherwise you tend to get into the catch 22-type 3 situation of saying: how do you know if somebody needs 4 to be monitored unless you're actually monitoring them? 5 The way you would do that on a modern site is you 6 would run what are called campaigns, so that as part of 7 the commissioning process and then every few years after 8 that you would run campaigns either with personal air 9 samplers which I described a few minutes ago, the little 10 pump and the paper on the lapel, you might also do urine 11 sampling. That would carry on for about a month, 12 perhaps a little longer, to establish whether there was 13 any indication of any significant dose whatsoever. If 14 there was no significant dose, which is normally the 15 case, then you would not introduce routine sampling but 16 you would repeat that campaign a few years later. 17 So you would still make a judgment as to whether 18 that kind of sampling was needed. I think where you're 19 coming from is: was there any indication that any of 20 that was done amongst the veterans on Christmas Island? 21 And I don't believe it was. I think the assumption was 22 simply that there was going to be no internal exposure 23 and the monitoring was based on that. 24 Q. Well, rightly or wrongly -- we may get into debating 25 whether it's right or wrong -- the whole process of</p> <p style="text-align: center;">Page 146</p>	<p>1 obvious. What we are concerned with today, the Tribunal 2 is concerned with, are what the potential long-term 3 effects may be of being in the vicinity of a nuclear 4 test. 5 A. Yes. 6 Q. The first nuclear explosions are taking place in 1945, 7 so taking the tests in 1958, there was at most 13 years' 8 experience of what the effects might be? 9 A. Yes. 10 Q. So the Tribunal is obviously trying to grapple in part 11 with that problem that this was a new form of human 12 activity. 13 I don't think I've seen, but maybe you could correct 14 me if I'm wrong, any detailed information about the 15 effects upon those involved with the original Manhattan 16 project in America. Have you seen any material to that 17 effect? 18 A. No, I haven't. 19 Q. What appears to have happened is that we have the first 20 two explosions, and within a year or two it was decided 21 that this was an ideal sample that you could at least 22 start carrying out research into what the effects of 23 a nuclear explosion might be on the long-term health of 24 people subjected to ionising radiation. 25 A. Sorry, you're talking about the inhabitants of Hiroshima</p> <p style="text-align: center;">Page 148</p>

1 **and Nagasaki?**
 2 Q. Yes, I am talking about what has been called in this
 3 Tribunal the LSS.
 4 **A. Yes.**
 5 Q. And of course what was being anticipated there was that
 6 there might be long-term effects of which people were
 7 unaware at that time?
 8 **A. Yes, yes.**
 9 Q. And indeed so it has proved although there's clearly
 10 argument about what those are.
 11 **A. Yes.**
 12 Q. It seems somewhat strange, given that there was going to
 13 be a programme of tests, first of all in Australia and
 14 then in the South Pacific, that so far as I can tell
 15 nobody at the time in the British Government said "Well,
 16 we ought to be carrying out a long-term survey to see
 17 what the effects of these tests are upon the people
 18 involved on behalf of Her Majesty's Government." Am
 19 I wrong in thinking that at the time no such steps were
 20 taken?
 21 **A. I don't think I can answer that. You mean in terms**
 22 **of: were there steps put in place in the late 1950s?**
 23 Q. Just to clarify my question, the question I am asking is
 24 this. Here we are, about to set off a whole series of
 25 increasingly large explosions.

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1 **A. Yes.**
 2 Q. We don't have much data on the long-term effects of such
 3 explosions upon people anywhere in the vicinity, whether
 4 it's going to be a mile away or 20 miles away, but we do
 5 have a sample here of several thousand young men who are
 6 going to be to a greater or lesser extent subjected to
 7 this. This will be an opportunity to add to our body of
 8 scientific information by monitoring them and seeing
 9 what happens.
 10 Am I right in thinking that there doesn't appear to
 11 have been that sort of thinking in the '50s?
 12 **A. Amongst the bulk of the soldiers I think that's correct.**
 13 **I think amongst the bulk of the soldiers the assumption**
 14 **and belief and judgment was that the exposures would be**
 15 **small. There were one or two groups who were much more**
 16 **closely involved around the Ground Zero area -- I'm**
 17 **talking about Maralinga now in Australia. There were**
 18 **one or two groups who were associated who were involved**
 19 **with much higher levels of radiation, the indoctrinee**
 20 **force in Maralinga, and they would have received much**
 21 **more significant doses because they actually marched**
 22 **into the area and did some work around the Ground Zero**
 23 **in the vicinity of Ground Zero. Whether there's been**
 24 **any follow-up of those people I don't know.**
 25 MR JUSTICE BLAKE: I suspect you are being asked about

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1 long-term studies or a baseline review or something,
 2 rather than simply: something has gone off, should we
 3 take a urine sample?
 4 MR TER HAAR: That's exactly right, my Lord.
 5 MR JUSTICE BLAKE: I have the --
 6 **A. I mean, I'm not aware of anything that was set up at the**
 7 **time, my Lord, but obviously there have been mortality**
 8 **studies which have been done since by Public Health**
 9 **England, by the Health Protection Agency I think at the**
 10 **time, the Muirfield studies, people like that, but they**
 11 **would be done retrospectively.**
 12 MR JUSTICE BLAKE: It is a retrospective analysis which
 13 really the delights of this case involves us in?
 14 **A. Yes.**
 15 MR JUSTICE BLAKE: I take it that your knowledge of these
 16 events, is that because you've been instructed by the
 17 Secretary of State as an expert or --
 18 **A. Yes.**
 19 MR JUSTICE BLAKE: -- did you have an interest in the
 20 history of radiological safety in the military context
 21 before?
 22 **A. No. Everything I've learned about that has been from**
 23 **the references, my Lord.**
 24 MR TER HAAR: I'm grateful. I am sort of using you in a way
 25 as a walking encyclopedia because you've done the

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1 research, but I fully accept there's a limit on what you
 2 know that isn't already in the documents we have.
 3 **A. And I'm also trying to be precise if you like as well,**
 4 **perhaps more so than is necessary, but I'm trying to**
 5 **indicate as well if there's areas where I'm really not**
 6 **sure.**
 7 MR JUSTICE BLAKE: If you are not sure, please let us know.
 8 **A. Yes.**
 9 MR TER HAAR: That is exactly what the Tribunal would expect
 10 of you. So thank you.
 11 Can we just look at the interplay between
 12 epidemiology and first of all your role as -- I'll call
 13 it broadly safety adviser. I know you have more
 14 specific roles.
 15 We looked in the questions I was asking you earlier
 16 at the gestation time of how long it takes from
 17 a hypothesis -- my hypothetical Australian -- through to
 18 legislation and the steps in between.
 19 One of the things which drives the setting of safety
 20 standards is obviously the results of epidemiological
 21 research.
 22 **A. Yes.**
 23 Q. That's absolutely fundamental to the whole of this
 24 issue.
 25 **A. Could -- yes, sorry, carry on.**

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<p>1 Q. If we just take the process from hypothesis through to 2 some specific measure being taken, it will tend to go 3 through the process of saying: is this statistically 4 significant; does this show us something we need to be 5 worried about; if so, what do we do? 6 A. Yes. 7 Q. The same process can work backwards, can't it? If you 8 are trying to work out what a dose level was at some 9 point in the past, one way of doing it is to look at 10 some health results suffered by a group of human 11 beings -- let's assume a statistically relevant 12 sample -- and say "If they suffered this consequence and 13 if it was caused by radiation there must have been this 14 level of dose at a site X years before". There are 15 a number of factual points in the chain there but you 16 can work backwards in that, can't you? 17 A. Sorry, could you just repeat the question? I think the 18 answer is yes. 19 Q. I'll give you an example which was given by 20 Professor Sawada last week and I think you were here 21 when he gave his evidence. 22 A. I was here for some but not all. 23 Q. Right. Let's just take one of the examples that he 24 gave. It has been assumed up to now that -- if 25 I understand his hypothesis right -- 2 kilometres from</p> <p style="text-align: center;">Page 153</p>	<p>1 but if you take those into account you can on occasion 2 work back to get a dose rate retrospectively. Would you 3 agree? 4 A. Yes, I think that's a reasonable proposition. I can't 5 comment on Dr Sawada's paper. I have no expertise in 6 Hiroshima. I've read his paper and I heard some of 7 his -- 8 MR JUSTICE BLAKE: I don't think you were being asked to. 9 It was an example for the general proposition: can you 10 sometimes work back from data to calculate dose? 11 A. Thank you, my Lord. 12 MR JUSTICE BLAKE: Or make some assumptions about dose? 13 A. I think it's reasonable to say the answer is yes. 14 MR TER HAAR: And the point I am making, perhaps rather 15 laboriously, is that epidemiology can inform the reader 16 of the papers both as to what the risks are going 17 forward, but also, subject to suitable caveats and 18 understanding of all the data, they may inform you 19 looking backwards retrospectively as to what the dose 20 rate must have been at a particular time? 21 A. As you say, subject to many caveats, yes. In principle, 22 yes, it could be done. 23 Q. And the reason I ask you about this is this. If there 24 was epidemiological evidence which powerfully suggested 25 that the dose rates which you have assessed at</p> <p style="text-align: center;">Page 155</p>
<p>1 the hypocentre or epicentre of the Hiroshima explosion 2 the risk of mortality from cancer was significantly less 3 than within a kilometre of the epicentre and he says, 4 well, if you look at the research done relatively 5 recently by the Hiroshima University the levels of 6 mortality at the 2-kilometre point are higher than if 7 you like the background population of Japan but the same 8 at 2 kilometres as at 1 kilometre. 9 For the moment I don't want to get into whether 10 that's the right reading of the data but let's assume it 11 is right. 12 So he says that must mean, if those deaths by cancer 13 are caused by radiation, that the level of fallout at 14 the 2-kilometre point must have been significantly 15 higher than people have so far assumed. You were here 16 when he was explaining that theory? 17 A. Yes, and I've seen his paper as well. 18 Q. Now there may be all sorts of methodological problems 19 with his paper. I'm not asking at the moment whether he 20 is right in that, but I use it as an example of how you 21 can at least in theory work back from a medical 22 consequence, a medical sequela, to what the dose level 23 must have been at a particular time. You obviously have 24 to work it out whether there are any other possible 25 causes of that particular death rate, mortality rate,</p> <p style="text-align: center;">Page 154</p>	<p>1 Christmas Island must be wrong by a significant margin, 2 that would be something you would agree should be taken 3 into account by the Tribunal in assessing the levels of 4 dose which were so to speak available to be taken by 5 each of the people on Christmas Island? 6 A. Yes, if there was -- again subject to the caveats in 7 terms of the reliability of the effect that was 8 observed, whether there were other factors that needed 9 to be taken into account, confounding factors. We've 10 heard quite a bit about chromosome aberration and 11 I think there have been questions raised as to whether 12 the chromosome aberration could be used to estimate dose 13 retrospectively in the way that you are suggesting. 14 I think it's been suggested that there are certainly 15 doubts as to whether that is possible because of the 16 other confounding issues, whether there are any other 17 possible causes of chromosome aberration, whether it's 18 practicable to do it over 50 years. 19 But in principle what you are describing, yes, 20 I think that would be a factor. 21 Q. Now, as you I think understand, this Tribunal is engaged 22 in what is a very unusual exercise of trying to identify 23 whether there are reasonable doubts. 24 A. Yes, I understand that. 25 Q. And it will be my submission at the end of this hearing</p> <p style="text-align: center;">Page 156</p>

1 that there's a credible body of scientific opinion which
 2 supports the view that the epidemiology casts
 3 considerable doubts upon the dose levels that you've
 4 assessed at Christmas Island. So before I go into that,
 5 can I just ask first of all have you in your assessment
 6 considered the epidemiological evidence from the Wahab
 7 and Rowland study?
 8 **A. I nearly said it I earlier but I thought I wouldn't.**
 9 **I have no expertise in epidemiology. I have read parts**
 10 **of papers or complete papers, in some cases, as part of**
 11 **my general education, general background knowledge, but**
 12 **I have no expertise in that area. Dr Haylock is**
 13 **an expert in epidemiology and I would suggest that if**
 14 **you have questions on the epidemiology that he would be**
 15 **the person to answer that.**
 16 Q. That's perfectly fair and that's what I anticipated.
 17 So this is not in any way a criticism, it's just
 18 establishing what you've done.
 19 **A. Yes.**
 20 Q. You have not yourself taken into account what the
 21 consequences or the implications might be of the Wahab
 22 and Rowland survey?
 23 **A. No, I've worked the other way. So I have started with**
 24 **a judgment as to what is the maximum likely levels of**
 25 **contamination that could exist on the island, and worked**

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1 **forward from that to estimate the doses that I believe**
 2 **could have resulted from that.**
 3 Q. As I say, I'm not criticising that as a process. I'm
 4 just trying to establish what the process is.
 5 **A. I understand.**
 6 Q. Again I think I know the answer to this but sometimes
 7 I'm surprised by witnesses; you would not suggest that
 8 it would be an error for the Tribunal in deciding what
 9 happened to take into account not only your evidence but
 10 also the epidemiological evidence?
 11 **A. Oh not at all.**
 12 Q. I didn't think you were suggesting that.
 13 **A. Yes. Quite on the contrary.**
 14 Q. So just to follow it through, don't get me wrong,
 15 I understand that there are many debates about the Wahab
 16 and Rowland survey but if, just right at the extreme
 17 which isn't where the scientific evidence goes but just
 18 to test the proposition, if the Tribunal came to the
 19 view that they were absolutely certain that the Wahab
 20 and Rowland study was hard fact -- and I am not
 21 suggesting that's where it gets to, just to test the
 22 proposition -- and that was inconsistent with what
 23 you've worked out at considerable length with great
 24 care, you would accept that that would cast a doubt, if
 25 I can put it to that extreme, on the work you've done?

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1 **A. Yes, subject to all the caveats about the nature of the**
 2 **paper, whether it actually does indicate the doses,**
 3 **et cetera. But given the proposition that you've just**
 4 **put that if the Tribunal were to decide that they were**
 5 **satisfied with that evidence, then, yes, that would**
 6 **certainly be a factor to take into account in terms of**
 7 **then assessing whether my estimates were valid.**
 8 Q. I put it in that very extreme way because I don't want
 9 to lure you into territory which is not your territory
 10 of how reliable that evidence is, et cetera.
 11 **A. Quite, thank you.**
 12 Q. Can I just ask, if we go back to the beginning of your
 13 report, one of the reasons I had to ask you about that,
 14 there is an oddity. If you go to page 9 which is the
 15 start of your text and paragraph 1 starts:
 16 "I am instructed by the Secretary of State for
 17 Defence to consider the evidence listed in appendix 2 to
 18 this report."
 19 We've hunted for appendix 2 and haven't found it
 20 yet. It may just be it didn't get photocopied. Is
 21 there an appendix 2?
 22 **A. The appendix 2 -- we realised this last night -- the**
 23 **appendix 2 is the list of references.**
 24 Q. Right.
 25 **A. So it's all of the list of references and I should make**

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1 **clear, if I could, to the Tribunal as well that some of**
 2 **these references are references that have been provided,**
 3 **some of these references are references that I have**
 4 **found. So it is a combination of what I referred to**
 5 **originally as appendix 2 and 3.**
 6 MR JUSTICE BLAKE: Can we just see where the references are?
 7 **A. I beg your pardon, this is on page 280 onwards.**
 8 MR JUSTICE BLAKE: 280 onwards.
 9 **A. And there are some references which I did take account**
 10 **of which are not listed here as an omission. I have**
 11 **taken account of all of the expert witness references**
 12 **produced by Mr Johnston and Professor Regan from the**
 13 **original First Tier Tribunal, so I've not specifically**
 14 **mentioned Professor Regan's expert witnesses but --**
 15 MR TER HAAR: What I am going to do in a moment, Mr Hallard,
 16 is I am going to actually take you to some of those,
 17 just to first of all identify whether you've taken them
 18 into account and secondly to see what's the interface
 19 between your expertise and theirs. So we'll get there
 20 as far as that is concerned.
 21 MR JUSTICE BLAKE: Could I just clarify then that page 280
 22 and following was meant to be your appendix 2, but you
 23 think, although this reference is to Johnson and Regan
 24 at 9, you've looked at for documents than you've
 25 actually recorded?

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<p>1 A. That's correct, my Lord.</p> <p>2 MR JUSTICE BLAKE: We'd better find out before you complete</p> <p>3 your evidence what you actually looked at.</p> <p>4 A. Would you like me to produce a list of the expert</p> <p>5 witness evidence?</p> <p>6 MR JUSTICE BLAKE: We'll see how we go but that might be</p> <p>7 a good idea.</p> <p>8 A. Right. It's all of the expert reports produced by</p> <p>9 Mr Johnson and Professor Regan for the original</p> <p>10 First Tier Tribunal.</p> <p>11 MR JUSTICE BLAKE: Obviously we will have a great deal of</p> <p>12 fun looking at history and summaries and things but just</p> <p>13 in order to have confidence in the cross-referencing it</p> <p>14 might be helpful.</p> <p>15 A. Yes.</p> <p>16 MR TER HAAR: My Lord, I think this is a little bit over</p> <p>17 halfway through the afternoon if we are finishing at</p> <p>18 3.30, if this would be a convenient moment? I am about</p> <p>19 to go to a different area, or we can carry on. Whatever</p> <p>20 suits the shorthand writers and the Tribunal.</p> <p>21 MR JUSTICE BLAKE: Yes. Then we will take a break anyway</p> <p>22 for our purposes. Back at 3 o'clock and then we will</p> <p>23 have half an hour.</p> <p>24 MR TER HAAR: Certainly, that's convenient.</p> <p>25 MR JUSTICE BLAKE: So we are going to take a break to rest</p> <p style="text-align: center;">Page 161</p>	<p>1 MR TER HAAR: After that it's Dr Busby's reports and the</p> <p>2 originals so that's why they've been taken out.</p> <p>3 MR JUSTICE BLAKE: Right.</p> <p>4 MR TER HAAR: I still have them in my copy. We are not</p> <p>5 going to those, so yours is still perilously full as</p> <p>6 a file but I think the Tribunal's might not be quite so</p> <p>7 bad.</p> <p>8 MR JUSTICE BLAKE: Yes. Why don't we take out tab 10?</p> <p>9 MR TER HAAR: We'll do that when we've finished rather than</p> <p>10 do that now because I am not going to go them.</p> <p>11 MR JUSTICE BLAKE: Right.</p> <p>12 MR TER HAAR: Could we go to tab 1, first of all. Now,</p> <p>13 tab 1 is a report from Dr Brenner who is an American</p> <p>14 academic. He is specialist in radiobiology and</p> <p>15 radiation biophysics, I think. Would this be one of the</p> <p>16 reports you read?</p> <p>17 A. No, I've never seen this before.</p> <p>18 Q. On to tab 2. Tab 2 is the first of a number of reports</p> <p>19 from Professor Regan, and this, I think it's clear from</p> <p>20 your report and what you said earlier you have read.</p> <p>21 A. Yes, I recognise this. It's quite some time since</p> <p>22 I read it.</p> <p>23 Q. Could we just go to the second page of it and just look</p> <p>24 at his experience and see how this compares with your</p> <p>25 experience because I want to see, as I said earlier,</p> <p style="text-align: center;">Page 163</p>
<p>1 the stenographers and for health and safety.</p> <p>2 A. But I won't speak to anyone.</p> <p>3 MR JUSTICE BLAKE: Please don't, thank you.</p> <p>4 (2.45 pm)</p> <p>5 (A short break)</p> <p>6 (3.00 pm)</p> <p>7 MR TER HAAR: As his Lordship has indicated, if you are more</p> <p>8 comfortable sitting at any point ...</p> <p>9 A. I am fine.</p> <p>10 Q. Could you take bundle SB11 which should be, I hope, in</p> <p>11 the rack behind you. (Pause).</p> <p>12 It does look as though everybody's SB11 is</p> <p>13 perilously overfull. I think we might produce an S --</p> <p>14 certainly the witness's SB11 looks thicker than</p> <p>15 everybody else's.</p> <p>16 MR JUSTICE BLAKE: Mine just has tabs 8 to 9. Your tab has</p> <p>17 been growing overnight.</p> <p>18 A. I start at tab 1 and go through to tab 10. SB11?</p> <p>19 MR TER HAAR: SB11. You ought to have, I hope, 1, 2, 3, 4,</p> <p>20 all the way through to 10.</p> <p>21 MR JUSTICE BLAKE: No.</p> <p>22 MR TER HAAR: If you do not have that --</p> <p>23 MR JUSTICE BLAKE: No. Up to 9.</p> <p>24 MS MCCORD: 9, yes.</p> <p>25 MR JUSTICE BLAKE: I think we are all up to 9.</p> <p style="text-align: center;">Page 162</p>	<p>1 where you stop and others continue, begin?</p> <p>2 A. Right.</p> <p>3 Q. In the italics at the top of the second page he says</p> <p>4 this: born in Leicester in 1967; studied physics at the</p> <p>5 University of Liverpool, got a degree; a PhD in</p> <p>6 experimental nuclear structure of physics, University of</p> <p>7 York.</p> <p>8 So certainly experimental nuclear structure of</p> <p>9 physics is a more advanced form of physics than you</p> <p>10 studied at Durham?</p> <p>11 A. Yes, it is.</p> <p>12 Q. And then:</p> <p>13 "Research positions Nuclear Physics Laboratories,</p> <p>14 Pennsylvania, and Australian National University."</p> <p>15 Then back lecturing physics at Surrey and you see</p> <p>16 a bit more and then if we go about a third of the way</p> <p>17 through do you see a sentence starting:</p> <p>18 "He has co-authored more than 190 peer review</p> <p>19 publications."</p> <p>20 Do you see that sentence about eight or nine lines</p> <p>21 down?</p> <p>22 A. Yes, I do.</p> <p>23 Q. "... peer reviewed publications in the field of</p> <p>24 experimental nuclear physics with particular focus on</p> <p>25 studies [the word "of" is missing] of the internal</p> <p style="text-align: center;">Page 164</p>

<p>1 structure of radioactive nuclear species using gamma ray 2 decay spectroscopy." 3 Again a more advanced area of science than yours, 4 I imagine? 5 A. Certainly. 6 Q. "... published a number of research articles on the 7 measurement and characterisation of levels of radiation 8 in the environment." 9 Now, measurement and characterisation of levels of 10 radiation in the environment is certainly something 11 which you've had to take into account as a safety 12 adviser in the nuclear industry? 13 A. To a very limited degree. I would say that I have no 14 expertise in environmental radiological protection. 15 I have tried to make that clear in my report but just to 16 be clear now, I do not have expertise in environmental 17 radiological protection. It does tend -- it's 18 a separate subject. 19 Q. And you are absolutely right, you've made that quite 20 clear, for example at paragraph 20 of your report. You 21 are very clear about that. But it seems to me there 22 might be some overlap where we're talking about 23 measurement and characterisation of levels of radiation, 24 that certainly within the context of a nuclear power 25 plant is an area which you would have to be involved in,</p> <p style="text-align: center;">Page 165</p>	<p>1 expertise with Professor Regan? 2 A. I'm not sure. Perhaps the easiest way to answer that is 3 if I try to make clear where my level of expertise lies 4 on that. 5 I have no expertise in the details of internal 6 dosimetry and again hope I've made that clear in my 7 report. So in terms of being able to identify the paths 8 and the particular nature of dose that would be received 9 by somebody following an intake of a radionuclide 10 I don't have specific and detailed expertise in that 11 area. 12 I am familiar with the use of the concept of what is 13 called a dose coefficient. A dose coefficient is 14 something that's published -- it's a series of numbers 15 which are published by principally the ICRP. And the 16 number itself is relatively simple. It says: for 17 a given nuclide -- let's take plutonium-239 as one which 18 I think people will have heard of -- if you receive 19 an intake of 1 becquerel of plutonium-239 you will 20 receive a dose of in this case, probably depending on 21 the nature of the particle size, et cetera, 47 22 microsieverts. 23 MR JUSTICE BLAKE: So the coefficient is the exposure to 24 dose -- 25 A. Yes.</p> <p style="text-align: center;">Page 167</p>
<p>1 wouldn't you? 2 A. Yes. 3 Q. That's a very hesitant "yes". 4 A. I'm thinking about what he actually means by 5 "characterisation" and I suspect what he means by that 6 is to identify the particular nuclides in a sample of 7 some sort. I've done a very limited amount of that, but 8 very limited, and at quite a low level of expertise, 9 just using an instrument called a gamma spectrometer, in 10 fact, which can be used to identify gamma-emitting 11 isotopes but not I think to this level of expertise that 12 Professor Regan is describing. 13 Q. You can probably understand what he writes about but you 14 wouldn't be the person who could write it? 15 A. I think that's probably true, certainly in terms of the 16 expertise that he clearly has on different nuclear 17 species and things like that, so I have some knowledge 18 in that but he will have a great deal more. 19 Q. Can we go to the end of the italics, the last sentence: 20 "He has lectured at postgraduate level to MSc and 21 PhD students on relevant areas including nuclear 22 experimental techniques ..." 23 I am not entirely sure what that means. 24 "... nuclear physics, radiation dosimetry." 25 Is that something which you could claim equal</p> <p style="text-align: center;">Page 166</p>	<p>1 MR JUSTICE BLAKE: -- calculation. 2 A. Yes, and in the case I was just describing that's 3 an inhalation coefficient. There are similar 4 co-efficients for ingestion for gamma exposure, and I am 5 familiar with use of those which is what a health 6 physicist would normally use. 7 I have a broad outline knowledge of the basics of 8 ICRP internal dosimetry modelling, simply because 9 I don't like using numbers as a black box, so that: here 10 is a number, do you have any understanding of it? So 11 I have an outline understanding of it to make sure that 12 I'm using it as intended but I don't have a detailed 13 understanding of the modelling and how you would derive 14 those numbers. 15 MR TER HAAR: Just to put a bit of colour on this it was 16 Professor Regan -- you may know this -- who identified 17 what happened to Mr Litvinenko. 18 A. Was it? 19 Q. That he had almost certainly been fed an alpha-emitter. 20 Perhaps you didn't know that. 21 A. I didn't know that. I knew it had been established very 22 late in his life within only a few days of his death but 23 I didn't know it was Professor Regan who did that. 24 Q. Whether that is right or not, that's the sort of 25 advanced specialisation he has which you don't have?</p> <p style="text-align: center;">Page 168</p>

<p>1 A. Yes, I mean I would -- I am familiar with the concept 2 again of urine sampling but in that context I would be 3 requesting a urine sample and I would be requesting that 4 that be sent off for analysis. Perhaps Professor Regan 5 got more deeply involved in the process of analysing and 6 discovering that it was polonium that was the source. 7 Q. My impression from your report, and I think I'm correct 8 in this, is that what you have done is taken 9 Professor Regan's reports -- and you also gave oral 10 evidence, I think -- you have certainly taken his report 11 and fed that into your process of reasoning and 12 analysis? 13 A. That's certainly my intention, yes. 14 Q. And -- 15 A. And the same thing for Mr Johnston. I have read the 16 transcripts as well, although there's a great deal of 17 information there. 18 Q. And I think there is no area in which you suggest that 19 Professor Regan has got it wrong and you've just taken 20 his material as being accurate. Is that a fair summary? 21 A. In terms of his description of nuclear physics and 22 health physics, is that what you mean? 23 Q. I think in any of the conclusions he comes to. 24 A. I can't think of a conclusion off the top of my head 25 where I've strongly disagreed with him. I think perhaps</p> <p style="text-align: center;">Page 169</p>	<p>1 we'll look in detail -- you'd accept that he hasn't in 2 any way stepped outside his appropriate field, it's just 3 different experts can differ about matters? 4 A. Yes, I've certainly not noticed any area where he 5 appears to have stepped outside of his field. 6 Q. Thank you. 7 Then, again this may be helpful for the Tribunal 8 just to see what we have, if you go to tab 3 there's 9 a short, two-page report by Professor Regan dated 10 5 October 2010 and I take it that you have also looked 11 at it and taken that into account? 12 A. Yes. If I remember this report correctly it basically 13 looked at the calibration of the film badges which were 14 used in Christmas Island, and if I remember the 15 conclusions I think he concluded that they were 16 reasonable. 17 Q. Yes. Well, we can look at it in detail but he had some 18 qualifications about what had been done. There's 19 nothing in that report that you would like to give 20 a health warning to the Tribunal about? 21 A. Nothing that I can remember, no. 22 Q. On to tab 4. I think this is probably where you 23 wouldn't have got yourself involved but maybe you did. 24 Professor Parker is an epidemiologist. 25 A. I've not seen this report.</p> <p style="text-align: center;">Page 171</p>
<p>1 there are one or two areas where he has indicated 2 qualitatively that a dose may be larger than the dose 3 which I've quantified but in terms of the principles of 4 it, no, I think from memory -- as I say, it's quite 5 a while since I've read these but from memory I don't 6 think so. 7 Q. Certainly where he has come to a higher qualitative 8 assessment than you have, whilst you might differ you 9 would accept that he's the person with appropriate 10 expertise whose views are legitimate alternative views 11 to yours? 12 A. Yes, I think that's -- yes, yes, I think I would agree 13 with that. I hope that in my report -- and I've 14 certainly sought in my report to break down and explain 15 in as transparent a way as possible where my estimates 16 of dose have come from, and from memory I don't think 17 Professor Regan has done that. There may be one or two 18 cases but I can't actually remember that being done in 19 that way. But forgive me if I'm wrong about that. 20 Q. I think it's fair to say that he's perhaps dealing with 21 things generally on a slight broader brush basis than 22 you have. 23 A. Yes, I think that's true. 24 Q. So broadly you find nothing to criticise in his report 25 from your standpoint. If there were differences -- and</p> <p style="text-align: center;">Page 170</p>	<p>1 Q. No, nor would I expect you to given what you've said. 2 So tab 5A, 5B, it's more of her evidence. Tab 6? 3 MR JUSTICE BLAKE: So that's likewise. Parker, outside? 4 A. Yes, I've not seen these reports. I don't recognise of 5 these. 6 MR TER HAAR: That's entirely understandable. 7 Tab 7 ... 8 MR JUSTICE BLAKE: 5A, 6. 9 MR TER HAAR: That's up to 5 and 6. 10 At 7 we get to Dr Mothersill. She's 11 a radio-biologist and I imagine again this would not be 12 part of your world, so to speak? 13 A. Again, I don't recognise this report. 14 Q. Then the last one in this bundle, Professor Sawada, 15 tab 9. You may or may not have seen it but it doesn't 16 really impinge on what you were asked to advise about at 17 all, does it? 18 A. Tab 9? 19 Q. Tab 9, yes. 20 A. Right. 21 MR JUSTICE BLAKE: This is an article. 22 MR TER HAAR: Its an article. 23 A. Again, I don't recognise it. I don't believe that I've 24 seen it. 25 Q. Then your bundle may contain a number of reports from</p> <p style="text-align: center;">Page 172</p>

<p>1 Professor Busby, but they've been taken from the 2 Tribunal's bundle so don't go to those.</p> <p>3 A. Okay.</p> <p>4 Q. Could you put that bundle aside, please, and go to 5 bundle 12. I am just doing the same exercise of trying 6 to identify what you've seen. So bundle SB12, please.</p> <p>7 The first divider contains quite a wide selection of 8 material but I can't believe there's anything here you 9 would have looked at. It's all to do very much with 10 medical conditions rather than --</p> <p>11 A. This is from tab 11 onwards; is that correct?</p> <p>12 Q. Tab 11 is the first one. Just skim read it. I would be 13 very surprised if you were given any of the material in 14 11.</p> <p>15 A. No.</p> <p>16 Q. 12 and 13 are reports from Mr Large. Now it's possible 17 you might have been given these because --</p> <p>18 A. I have seen one report from -- is it Professor Large?</p> <p>19 John Large anyway.</p> <p>20 Q. Mr Large.</p> <p>21 A. Okay.</p> <p>22 Q. So you may have looked at one or other of these?</p> <p>23 A. From memory I've looked at one of his. Whether this is 24 the one, I would need to look at this again to be sure 25 that this was the one.</p> <p style="text-align: center;">Page 173</p>	<p>1 Government annexes show, which appear to deal with 2 questions of amounts of external radiation dose receipt, 3 as he calls it, and radiation data.</p> <p>4 So I just wonder why did you not comment upon this 5 material?</p> <p>6 A. Sorry, we are on page 2?</p> <p>7 Q. I was just looking at page 2. If you just cast your eye 8 down it --</p> <p>9 MR JUSTICE BLAKE: This is Large second statement, tab 13.</p> <p>10 MR TER HAAR: Yes, I'm sorry.</p> <p>11 MR JUSTICE BLAKE: Page 2, the paragraph numbering is 12 a little faint.</p> <p>13 MR TER HAAR: Yes, I think --</p> <p>14 MR JUSTICE BLAKE: "My review"?</p> <p>15 MR TER HAAR: Yes. I think it must be paragraph 12 16 originally, but (i) to (iii) and then 1, 2, 3.</p> <p>17 MR JUSTICE BLAKE: So it's what we think is paragraph 12, is 18 that what you are asking this witness about?</p> <p>19 MR TER HAAR: Yes.</p> <p>20 MR JUSTICE BLAKE: Yes.</p> <p>21 A. I'm not sure if this is the same report that I've read.</p> <p>22 Q. That explains why you didn't comment on it.</p> <p>23 A. Yes. I'll have to admit to a vulnerability on this that 24 it is so long -- it's perhaps a year since I've read 25 some of these reports. That's when I first started</p> <p style="text-align: center;">Page 175</p>
<p>1 Q. Right.</p> <p>2 A. The one that I read was principally about the height of 3 the detonation of the --</p> <p>4 MR JUSTICE BLAKE: That's that one, isn't it?</p> <p>5 MR TER HAAR: That is Dr Nicholson. That's likely to be, 6 although there is part of this that deals with this. If 7 you go to page 3, yes, page 3 of tab 12, we have some 8 data as to the height of the Grapple Y detonation there.</p> <p>9 MR JUSTICE BLAKE: Is that the one you were referring to?</p> <p>10 A. It could be. It's been a long time since I looked at 11 them, my Lord.</p> <p>12 MR JUSTICE BLAKE: You are going to provide anyway this 13 supplementary appendix 2 which might make it clearer.</p> <p>14 A. Yes.</p> <p>15 MR JUSTICE BLAKE: Right.</p> <p>16 MR TER HAAR: Now, my recollection is that you don't comment 17 in your report about either of the two Mr Large 18 statements at 12 and 13. I assume that's right, first 19 of all, is that your recollection as well?</p> <p>20 A. It is my recollection. Particularly the areas of the 21 height of detonation, I didn't feel that I had any 22 expertise to be able to comment on that.</p> <p>23 Q. But there is an overlap between what he comments on and 24 your report. Take, for example, the second page of 25 this. He's commenting on what he describes as certain</p> <p style="text-align: center;">Page 174</p>	<p>1 working on this. I don't have a number of these reports 2 electronically either, so it would be difficult for me 3 to confirm whether this is the report. From a quick 4 skim read it does not look familiar. Was there a second 5 report from John Large?</p> <p>6 Q. There were two reports from him. The first report is 7 tab 12 and then the second report, which he calls a 8 statement, at tab 13.</p> <p>9 A. Ah, I can't be sure. I would need to go through it in 10 more detail, but I have a feeling that this is the 11 report that I've seen.</p> <p>12 Q. By "this" you're referring to tab 12?</p> <p>13 A. Tab 12. Please don't take that as a definitive 14 statement, I would need to go through it again, but 15 I believe from a quick look that that certainly looks 16 more familiar than the paper in tab 13.</p> <p>17 Q. All right.</p> <p>18 MR JUSTICE BLAKE: Would you like this witness to refresh 19 his memory by Monday about this paper, or it's not 20 a topic you are going to pursue with him?</p> <p>21 MR TER HAAR: I'm not going to pursue it at any great 22 length. I'm most interested in the ones that Mr Hallard 23 has looked at --</p> <p>24 MR JUSTICE BLAKE: Yes.</p> <p>25 MR TER HAAR: -- rather than those he hasn't.</p> <p style="text-align: center;">Page 176</p>

<p>1 MR JUSTICE BLAKE: This is an ambiguous category.</p> <p>2 MR TER HAAR: Divider 14, another report from</p> <p>3 Professor Regan.</p> <p>4 This probably is something that I think you would</p> <p>5 have looked at. Because, for example, at page 7 he's</p> <p>6 got a section headed, "Additional notes on radiation</p> <p>7 measurement and detection", and perhaps of significance,</p> <p>8 it's a matter for the Tribunal, at paragraph 55 at the</p> <p>9 bottom of that page he comments that personal dosimeters</p> <p>10 don't give any measurement for internal ingestion or</p> <p>11 inhalation of radiation.</p> <p>12 A. Sorry, which tab is this?</p> <p>13 Q. Sorry, tab 14, and I was taking you to page 7. I'm</p> <p>14 sorry if I am mumbling a bit. I am pointing out that</p> <p>15 halfway down the page --</p> <p>16 A. Sorry, forgive me, which paragraph number are you</p> <p>17 looking at?</p> <p>18 Q. First of all, get the cross heading, "Additional notes</p> <p>19 on radiation measurement and detection". Then 55 is</p> <p>20 where I was taking you to.</p> <p>21 MR JUSTICE BLAKE: It looks like you are getting lost.</p> <p>22 What's your tab 14, please?</p> <p>23 A. It is Maralinga report by Professor PH Regan.</p> <p>24 MR TER HAAR: No wonder! There should be a 14, headed on</p> <p>25 the first page "Supplementary report by PH Regan".</p> <p style="text-align: center;">Page 177</p>	<p>1 MR TER HAAR: No, I moved on. No, paragraph 55 at page 7</p> <p>2 starts with the words "Personal dosimeters" in the</p> <p>3 version I have.</p> <p>4 A. I thought I'd found the paper.</p> <p>5 MR JUSTICE BLAKE: That's another report.</p> <p>6 A. Right.</p> <p>7 MR JUSTICE BLAKE: Where is that one you've just found?</p> <p>8 What is that called in your bundle? Does it have a tab</p> <p>9 number?</p> <p>10 A. It's still under tab 14.</p> <p>11 MR JUSTICE BLAKE: Right. Tab 14 has now been divided into</p> <p>12 three.</p> <p>13 A. Ah.</p> <p>14 MR JUSTICE BLAKE: What you've just been referring to is our</p> <p>15 tab 14A, if this is of help to anybody who is</p> <p>16 discovering the archaeology of the bundles. We are all</p> <p>17 on the same. We have 14, 14A and 14B, and we have the</p> <p>18 master indexes, so one can compare what we have with</p> <p>19 what we should have. If there are going to be additions</p> <p>20 to our bundles through the clerk --</p> <p>21 MR TER HAAR: We will take it that what the Tribunal has is</p> <p>22 the master copy from which the rest of us will --</p> <p>23 MR JUSTICE BLAKE: Otherwise we will need a Japanese</p> <p>24 interpreter.</p> <p>25 MR TER HAAR: Yes.</p> <p style="text-align: center;">Page 179</p>
<p>1 MR JUSTICE BLAKE: You are at our 14B.</p> <p>2 MR TER HAAR: It looks as though we have a bundling problem.</p> <p>3 Let's pass over that. We can make sure everybody's</p> <p>4 bundles are the same by Monday, otherwise we'll get very</p> <p>5 lost.</p> <p>6 MR JUSTICE BLAKE: Yes, all right, it looks like your bundle</p> <p>7 is defective.</p> <p>8 DR BUSBY: We have the same --</p> <p>9 MR TER HAAR: We will make sure everybody --</p> <p>10 MR JUSTICE BLAKE: That is a conversation between you over</p> <p>11 there. But anyway --</p> <p>12 MR TER HAAR: The only thing I would ask, just while we are</p> <p>13 on this as a matter of practicality, if you are not</p> <p>14 dying to have the bundle yourself over the weekend if we</p> <p>15 could have access to SB12 --</p> <p>16 MR JUSTICE BLAKE: You are not going to have access to our</p> <p>17 bundles now. I am going to bring the shutter down on</p> <p>18 that, because we are starting to note up things and I am</p> <p>19 going to say things about that at the end.</p> <p>20 MR TER HAAR: We will have to liaise with the clerk.</p> <p>21 MR JUSTICE BLAKE: Do it through the clerk.</p> <p>22 MR TER HAAR: We just need to find the machinery. Anyway,</p> <p>23 let's carry on.</p> <p>24 A. I am sorry, did you say paragraph 55 says "with regard</p> <p>25 to the use of sticky paper"?</p> <p style="text-align: center;">Page 178</p>	<p>1 Mr Hallard, if you go on, please, to tab 15. That,</p> <p>2 I hope, has at the top of it the the names Guy Higginson</p> <p>3 and Nick Crossley, or are we beginning to lose each</p> <p>4 other again? Tab 15.</p> <p>5 A. I have under tab 15, final report by Dr Thomas</p> <p>6 Lindahl --</p> <p>7 MR JUSTICE BLAKE: Okay. This bundle is in a hopeless</p> <p>8 state.</p> <p>9 MR TER HAAR: It really is.</p> <p>10 MR JUSTICE BLAKE: Stop, there's no point going on.</p> <p>11 MR TER HAAR: I am wasting the Tribunal's time.</p> <p>12 Let's see whether --</p> <p>13 MR JUSTICE BLAKE: Can someone hand -- well, I think someone</p> <p>14 from your team if they have the time and the patience</p> <p>15 should go through the witness' bundle to make sure it's</p> <p>16 in good order.</p> <p>17 MR TER HAAR: I always like giving work to other people. It</p> <p>18 will be done.</p> <p>19 MR JUSTICE BLAKE: Thank you, yes. If you negotiate with</p> <p>20 our clerk about locking up times of the courtroom, you</p> <p>21 may be allowed out at the weekend.</p> <p>22 MR TER HAAR: And I see the time. So rather than have</p> <p>23 another exercise with the next bundle let's make sure</p> <p>24 we're all online together.</p> <p>25 MR JUSTICE BLAKE: Please, let's do that. I think we are</p> <p style="text-align: center;">Page 180</p>

1 obviously hitting some technical problems on our side
 2 here so I think we will interrupt your evidence.
 3 **A. Yes, my Lord.**
 4 MR JUSTICE BLAKE: We will meet again on Monday. 10.30
 5 Monday?
 6 MR TER HAAR: That's fine by me.
 7 MR HEPPINSTALL: Dr Haylock is here but he was hoping that
 8 he could be released and he doesn't have to be here on
 9 Monday and will return on Tuesday.
 10 MR JUSTICE BLAKE: I think you are going to be --
 11 MR TER HAAR: If we get to Dr Haylock on Monday we will have
 12 shaved so much time off this hearing that we'll all want
 13 to go to the bar and have a glass of champagne.
 14 MR JUSTICE BLAKE: Depending on what is happening in France.
 15 MR TER HAAR: Putting it seriously, we are unlikely to get
 16 to him and if we do we will be well ahead of timetable.
 17 MR JUSTICE BLAKE: We can release Dr Haylock until Tuesday.
 18 MR TER HAAR: Absolutely.
 19 MR JUSTICE BLAKE: At some point at the end of Monday we
 20 might review, 10, 10.30, but for Monday 10.30.
 21 MR TER HAAR: Please.
 22 MR JUSTICE BLAKE: So I have some other things to raise with
 23 you but we can let the witness go home. Thank you very
 24 much --
 25 **A. Thank you, my Lord.**

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1 MR JUSTICE BLAKE: -- for today. We will continue with your
 2 evidence where I think the estimates are you'll be most
 3 or all of Monday.
 4 **A. Yes, my Lord.**
 5 MR JUSTICE BLAKE: We'll continue at 10.30, then I hope
 6 we'll complete your evidence by Monday afternoon.
 7 **A. Thank you, my Lord.**
 8 MR TER HAAR: I think that might -- the estimate was three
 9 and a half days, which may be too long but finishing by
 10 Monday afternoon is likely to be --
 11 MR JUSTICE BLAKE: I misunderstood. Yes, we'll certainly be
 12 with you on Monday and possibly Tuesday.
 13 **A. Okay.**
 14 MR TER HAAR: I think that's more realistic, I'm afraid.
 15 MR JUSTICE BLAKE: Yes, very good. There was nothing else
 16 you wanted him to read over the weekend to refresh his
 17 memory in order to avoid further delays?
 18 MR TER HAAR: We must obviously sort out the bundles but
 19 nothing for Mr Hallard.
 20 MR JUSTICE BLAKE: It would probably be helpful if he did
 21 have a complete list of what you actually have read
 22 available, just to cut that process down. Thank you.
 23 (The witness withdrew)
 24 Housekeeping
 25 MR JUSTICE BLAKE: So did anybody else have issues of

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1 management for next week to raise with me? No, right.
 2 Sorry, I just have to make sense of my notes.
 3 Yes, one issue: when we looked at the report behind
 4 the formal article about New Zealand -- the Wahab
 5 results -- Dr Rayner made reference in the questions she
 6 posed to Professor Thomas about an article on Polynesian
 7 radiation rates. Do you know what I'm talking about?
 8 MR HEPPINSTALL: I remember the --
 9 MR JUSTICE BLAKE: It's a reference cited --
 10 DR RAYNER: Violet.
 11 MR JUSTICE BLAKE: Thyroid cancers amongst the Polynesian
 12 community. I don't know, is that a paper that is
 13 somewhere to be found for the curious observer in our
 14 other papers or is that outside?
 15 MR HEPPINSTALL: No.
 16 MR JUSTICE BLAKE: Just in order to track down any reference
 17 which has emerged, might it be an idea if it was
 18 available so you can at least consider whether it has
 19 relevance to any of the issues?
 20 MR HEPPINSTALL: We can certainly do that for you.
 21 MR JUSTICE BLAKE: Thank you. It's best to do it that way
 22 round.
 23 Two, we did I think borrow and get a screen in case
 24 we needed a slide show for any part of the
 25 cross-examination of Professor Sawada. I think we've

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1 managed to do without it. Are we likely to need that
 2 for next week?
 3 MR TER HAAR: Not as far as I'm concerned. I don't know
 4 whether Professor Busby thinks we do.
 5 DR BUSBY: My Lord, I'm told that we want to project some of
 6 these photographs onto it because the quality of the
 7 photographs that were provided --
 8 MR JUSTICE BLAKE: So you might need it for next week. All
 9 right, we'll keep it on. I just don't know whether I've
 10 got to give it back to someone else at some stage.
 11 Right, I haven't had a chance to read those e-mails
 12 that you handed up and I don't want to say anything more
 13 about it, but I think we're all very sorry that the
 14 witness who has received these should have received
 15 things which are alarming and intimidating, and as far
 16 as I'm concerned if you could pass on my regret that
 17 that's happened to Professor Thomas I would be grateful.
 18 MR HEPPINSTALL: We will, my Lord.
 19 MR JUSTICE BLAKE: Thank you.
 20 Right, well, then have a good weekend and see you
 21 Monday at 10.30.
 22 (3.35 pm)
 23 (The court adjourned until Monday 20 June 2016 at 10.30 am)
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 25 PROFESSOR GERALDINE THOMAS1

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